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CAPACITY DEVELOPMENT FOR SCALING UP CLIMATE-SMART AGRICULTURE (CSA) INNOVATIONS: AGRICULTURAL EXTENSION'S ROLE IN MITIGATING CLIMATE CHANGE EFFECTS IN GQUMASHE COMMUNITY, EASTERN CAPE, SOUTH AFRICA

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ABSTRACT

This study aimed at ascertaining what role agricultural extension plays in mitigating the effects of climate change and variability using farmers' perceptions in Gqumashe village, Raymond Mhlaba Local Municipality, Eastern Cape, South Africa. The survey research design was adopted for the study, and data for the study were collected from 50 respondents using a convenience sampling method in the study area. Data was analysed using SPSS and descriptive statistics (means, percentages and graphs) were produced. Farmers in the study area were aware of and perceived climate change and variability as detrimental to agricultural production as they reported various problems associated with changes and variability in climate to their extension workers and other available agricultural officials. The paper concludes by making three recommendations: a) Extension agents as the disseminators of information to farmers need to conduct targeted training for farmers in order to raise more awareness about climate change and variability as a subject; b)Extension agents need to visit farmers regularly and also provide information on current issues related to farming, new technology development for agriculture and farming, climate change and variability issues, as well as training about new agricultural techniques to counteract climate change and variability effects; and c) Extension agents need to proactively meet the expressed need for market information and storage facilities.

Keywords: Perceptions, capacity development, climate smart agriculture, agricultural extension

1. INTRODUCTION

1.1 Background

The Intergovernmental Panel on Climate Change (IPCC, 2014) refers to climate change as a "change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer". The problem of climate change and its effects are a global concern (Davendra, 2012). Climate change is seen to be developing as one challenge that people will have to face in the future. Climate is one of the most important factors associated with agricultural productivity and climate change affects agriculture in numerous ways and affects the world environmentally, socially and economically. Agriculture, as both an area of

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human activity at risk from climate change as well as a driver of climate and environmental change, features prominently in the global climate change agenda (FAO, 2016). Crop production is one aspect of the food systems that is most affected by climate change (Chijioke, Haile & Waischkeit, 2011). Crop failure, in relation to climate change is mainly triggered by drought, floods, heavy winds, hailstorm and all other extreme weather events. Benhin (2010) states that, given the already high temperatures in Africa, including South Africa, climate change may displace many crops currently being cultivated, especially in rain-fed farming areas.

With the increasing evidence of climate change affecting agricultural practices globally and particularly the African continent, capacity development is one of the strategies that needs to be promoted in addressing this challenge. According to FAO (2013), Climate Smart Agriculture (CSA) is agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals. Capacity development should develop skills, knowledge and attitudes on CSA for both extensionists and farmers and is one of the strategies that can be best employed to scale up CSA. According to Bolger (2000), capacity development is defined as "approaches, strategies and methodologies used to improve performance at the individual, organisational, network/sector or broader system level". Effective capacity development goes beyond training, technical assistance and policy support, it also aims to facilitate a sustainable and endogenous development process, rooted in national empowerment that enables the recipients of development intervention to be in the driving seat of their own destiny (FAO, 2013). The role of extension agents is often perceived as providing a crucial link between food producers and necessary sources of information and tools allowing food systems to be prepared for climatic changes. In order to provide effective support to farmers, extension agents themselves need to be supported by a conducive environment formed by appropriate policies, governance, legislation, infrastructure, resources (both human and financial), and strongly linked with local communities. According to Rasheed Suleiman of the Global Forum on Rural Advisory Services (GFRAS), extension agents need capacity strengthening at three levels to effectively fulfil their role within CSA:

a) Enabling environment: Extension agents should be well connected with other relevant actors that are key to climate smart agriculture. They also need to engage with local institutions to gain political commitment to promote the CSA approach.
b) Organisational level: Extension agents should be more aware of national level policies and action plans and interact more with national authorities. Advocacy for rural advisory services (RAS) could help in identifying funding opportunities for CSA work with farmers.
c) Individual level: Extension agents currently experience weak technical knowledge on climate change. Stronger communication, networking, facilitation and partner engagement capacities would help agents to work more efficiently when supporting farmers in implementing CSA approaches.

Furthermore, agricultural extension is a process of working with farmers in order to improve their production and overall livelihoods. Farmers need ample knowledge on the issue of climate change and climate variability in order to help them gain a better understanding on how to adapt to these changes. Extension agents need to provide research results from researchers about climate change so that farmers could become more aware and fully equipped with requisite expertise. This could help farmers identify and capitalise on strategies to cope with the variability of climate. Training and equipping through extension can assist farmers to better

cope with and find appropriate solutions to counter the effects of climate change and variability on crop production through, for example, the adoption of new agricultural practices and technology. Where appropriate, agricultural extension may also help to build up local farmers' groups and organisations so that they can benefit from extension programmes and to aptly provide social support to individual member farmers. Agricultural extension, therefore, provides the indispensable elements of knowledge that farmers need to improve their agricultural productivity. Extension education as a capacity building strategy is key as it contains information on the character of variability and climate change in agricultural production as well as measures to enhance people's capability to better cope with associated negative effects on their livelihoods. According to Van Niekerk *et al*. (2011), the South African agricultural extension service is challenged to improve food security, develop the rural areas through agricultural activity and to create sustainable jobs in farming. Extension officers' tasks include disseminating useful information to farmers and helping them to gain knowledge so that they may improve their standard of living. With regards to the broader concept of capacity development, extension officers also need more training before they can train those that they are sent to assist, and this could be achieved through continuous or short-course training.

1.2. Objectives

The objectives of the paper are to:

- Assess farmers' perceptions on climate change and variability in the study area;
- Examine how farmers are coping with climate change in the study area; and
- Ascertain agricultural extension agents' role in mitigating climate change in the study area.

2. METHODOLOGY

Smallholder farmers of Gqumashe Village were the target population and their perceptions regarding the effect of climate change were investigated. Convenience sampling method was used on a sample of 50 respondents in this study. Convenience sampling is also known as accidental sampling. The study was conducted using the survey research design. In this process, semi-structured questionnaires were administered to farmers through a one-on-one data collection method. The goal was to provide an opportunity for farmers to express themselves freely, in addition to the closed-ended questions. Collected data were then coded and captured into a Microsoft Excel spreadsheet and analysed with the Statistical Package for the Social Science (SPSS) software programme.

3. RESULTS

3.1. Demographic characteristics of farmers in the study area

3.1.1. Gender make-up and age of the respondents

Table 1: Age of the study respondents

Age	Frequency	Valid Percent
18-29	3	6
30-39	10	20

40-49	3	6
50-59	18	36
61 or older	16	32
Total	**50**	**100**

Table 1 illustrates the age distribution amongst the participants, showing that 36% of the farmers that participated in the survey are between the ages of 50 and 59 years, the highest in number. There is a gender-linked distribution of economic roles in the rural economy of the Eastern Cape, where men are involved in farming while women undertake petty/ retail trading. However, the study population is in contrast to this, as out of the 50 study respondents, only 18 were males and 32 were females. Therefore, 64% of respondents comprised of females who actively participated in the study. As far as age is concerned, Table 1 depicts the situation. One of the challenges affecting rural areas in South Africa is the migration of youth to urban areas, leaving many old people to take most of the farming work. This has a detrimental effect because older people are aging and eventually will not have the energy needed to perform the production activities for a thriving agricultural enterprise. Even though older people have less energy, their indigenous knowledge and experience are acknowledged, and can be shared with young people.

3.1.2. Education

Table 2: Respondents' highest educational level

Education Level	**Frequency**	**Valid Percent**
Primary School	22	44
Secondary School	26	52
Tertiary	2	4
Total	**50**	**100**

In the study area, the level of education was weighted based on the formal education the participants have received. Based on the findings, farmers' education is relatively low, as only 4% exceeded Grade 12, which could become a setback to proper decision-making by farmers in the study area. According to Pender and Hazell (2000), poverty and inadequate education are two reasons for poor farming decisions made by farmers.

3.1.3. Off-farm employment

Employment in off-farm activities by farmers could be positive or negative in its influence on farmers' perception and farm decision making. Farmers who are not involved in farming full-time may end up not giving enough time to achieve the full benefits which agricultural production could provide. However, income from off-farm activities can become a great source of financial resources for the improvement and development of the farm business. In the study area, the majority of farmers (68%) are unemployed, suggesting that the positive influence which off-farm income provides for the development of farming is lacking in the area. The unemployment rate in South Africa increased to 25.5% in the third quarter of 2015 from 25% in the previous period (Trading Economics, 2015). Trading Economics (2015) further states that the number of the unemployed rose to 3.6% while employment went up at a slower rate, at 1.1% and more people joined the labour force. According to StatsSA (2011), the

unemployment rate in South Africa averaged 25.27% from 2000 until 2015, reaching an all-time high of 31.20% in the first quarter of 2003 and a record low of 21.50% in the fourth quarter of 2008. The employment status of Gqumashe village is reflected in Figure 1.

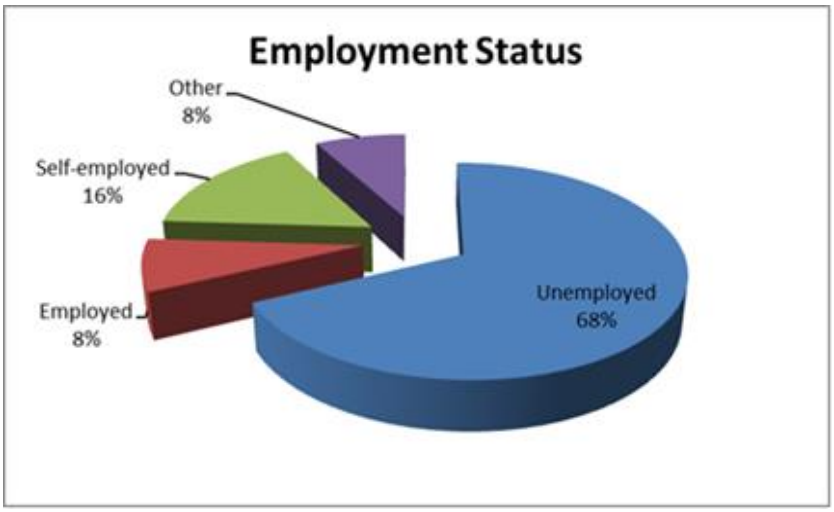

Figure 1: Employment status of the study respondents

3.1.4. Income

Income plays a significant role in the success and sustainability of any business venture. It is actually a major benchmark measure of the United Nations and most countries for the poverty situation of any people. According to Pender and Hazell (2000), poverty and education are two main reasons for poor farming decisions made by farmers. In the study area, 86% of farmers earn an income of R2000 and below. The income of respondents in the study area does not compare with the R2400 indicated as the poverty line for South Africa, and it is far below the R3500 minimum wage being currently advocated by the ANC-led government for South Africa, emphasising the poverty level of farmers in the study area, which is a negative influence on proper farm decisions.

3.1.5. Land ownership

Table 3: Respondents' access to land ownership

Land ownership	**Frequency**	**Valid Percent**
less or equal to 0,5 Hectares	17	34
0,6 to 0,9 Hectares	13	26
Between 1 and 5 hectares of land	20	40
Total	**50**	**100**

Land redistribution and acquisition in this area is a challenge as most farmers own small areas of land. From the interviewed candidates, no farmer owns more than 5 Hectares of land for crop production. The size of farm a farmer owns is another great factor in improving the capacity of farmers to adopt agricultural innovations. It also shows the level of production of farmers in an area. Farmers who own large farms have more capacity for agricultural development and to adopt new innovations, since they suffer less from negative influences and

risks and have better opportunities for income generation. The results above suggest that those who own larger portions of land are more knowledgeable on how to efficiently utilise small portions of land in creating sustainable enterprises.

3.1.6. Access to markets

Table 4: Respondents' access to markets

Market Access	**Frequency**	**Valid Percent**
Formal market	2	4
Informal market	41	82
Subsistence purposes	7	14
Total	**50**	**100**

Based on the current findings, a larger percentage (82%) use informal market channels for their crops. This is in agreement with several literature findings for smallholder farming. Due to the fact that many of the farmers are inadequately educated, they lack market appropriate information that will enhance their income. As such, they end up selling their crops to neighbours and at local markets, which indirectly becomes a negative influence on their capacity development.

3.2. Farmers' perceptions on climate change and variability on crop production

Farmers in the study are aware of the changes and variability of climate and this worries them as they suggested that receiving poor services from extension agents hampers response ability against the effects of climate change. It is very important for farmers to have some knowledge on climate change to enable them to easily adopt mitigation strategies proposed. The perceptions of farmers are depicted in Table 5.

Table 5: Farmers' perceptions on climate change and variability

Farmers Perceptions		**Frequency**	**Valid Percent**
Knowledge on climate change	Aware about climate change	45	90
	Not aware about climate change	5	10
Total		**50**	**100**
Farmers' use of Indigenous Knowledge	Farmers find it reliable	30	60
	Farmers find it not reliable	16	36
	Farmers find it very reliable and use it often	2	4
Total		**50**	**100**
Farmers' Perceptions on the Causes of Climate Change	Climate change is caused by human activities	23	46
	Climate change is caused by natural causes	27	54
Total		**50**	**100**

The large majority of farmers (90%) are aware of the changes and variability of climate, they have at least some knowledge about this matter, its causes and what adaptation measures to take to cope with it. The table above also illustrates the use of indigenous knowledge to curb the effects of climate change and variability, and how harmful it is to farming activities. As such, 60% of farmers strongly believe that indigenous knowledge is reliable, 36% believe that it is not reliable, and 4% believe that it is very reliable knowledge that they use. It is vital for farmers to be aware of what causes climate change, and this will need to be championed by extension officers. Most farmers in the study believed that climate change and variability is caused by natural causes, while others believed that it was God punishing them for their bad behaviours and human activities.

3.3. Coping strategies with climate change effects

Farmers of Gqumashe Village have developed a number of strategies to cope with climate change and variability, such as practising crop rotation, changing the time of farmer operations, introducing diverse crop varieties, increased irrigation, promoting climate change awareness and education amongst each other, working together with other farmers, introducing new crop cultivars, using different planting dates, and promoting crop diversification. Some of the coping strategies are reflected in Table 6.

Table 6: Coping strategies used by farmers

Coping Strategies	**Frequency**	**Percentage**
Crop Rotation, Operation Timing, Crop Diversification, Irrigation, Awareness	19	38
Co-operation, New Crop Types, Different Planting Dates	12	24
All of the above	15	30
Own different coping strategies preferred	2	4
None	2	4
Total	**50**	**100**

The results show that 4% of the respondents do not use any of the previously mentioned coping strategies. A small percentage of farmers even had their own preferred strategies such as planting drought resistant crops and construction of dams for irrigation. Furthermore, 30% of farmers use all of the aforementioned coping strategies when circumstances allow them.

3.4. Agricultural extension's role in farmers' capacity to mitigate climate change in the study area

Table 7: Status of extension services

Extension Services	**Frequency**	**Valid Percent**
Access to extension assistance	16	32
Limited/no access to extension assistance	34	68
Total	**50**	**100**

According to the findings, the larger proportion (68%) of farmers said that they have limited or no access to extension services in the study area. In fact, some of the respondents said it has

been years since extension officers visited their area. Agricultural extension is the most important source of information for farmers (Agbamu, 2002). Adequate access to extension services has a great role to play in enhancing farmers' capacity to improved perception and adoption of agricultural innovations such as climate change. The Nguni cattle project study conducted in Raymond Mhlaba Local Municipality (the then Nkonkobe Local Municipality) by Gwala, Monde and Muchenje (2016), alludes that beneficiaries received no extension support services to improve their socio-economic status and also to market their animal produce. This seems to be the norm in most parts of developing countries, especially in sub-Saharan Africa (Maoba, 2016). Irregular visits of extension officers can lead to farmers complaining about invisibility and could impact negatively on extension activities. This also helps to explain the lack of climate change specific extension education; the fact that the current service is limited in reach. Efforts are therefore needed for stronger or more effective extension support. This is key, and government needs to equip both newly recruited and existing extension cadre with CSA knowledge and skills.

4. IMPLICATION FOR EXTENSION AND RECOMMENDATIONS

The results of this study indicate that extension services, with respect to capacitating smallholder farmers in how best to mitigate climate change effects is sub-optimal. However, one of the likely reasons for this is that extension workers in the area have been less capacitated themselves to deal with the current challenge of climate change and variability. Farmers need to be reached and assisted by well-trained and knowledgeable extension officers within a well-managed extension service using different approaches. Participation by consultation and interactive participation are possible and perfect types of participation to use when working with farmers. There should also be specific CSA related training programmes for extension officers to enable them to be well prepared to assist farmers in dealing with the challenge of climate change.

5. CONCLUSION AND RECOMMENDATIONS

The analysis of this study showed that there is awareness and adaptation of farmers to climate change and variability in lower and upper Gqumashe Village. Most farmers believed that climate change and variability is caused by natural causes while other farmers believed that it was as a result of punishment from God and human activities. Many farmers made use of indigenous knowledge and warning indicators to adapt and find strategies to cope with and mitigate climate change and variability. This is because they had experienced declines in production as a result of this phenomenon. Based upon the study results, the following recommendation are made:

- Extension agents, as the disseminators of information to farmers, need to conduct training for farmers in order to raise more awareness about climate change and variability as a subject.
- Extension agents also need to visit farmers regularly and provide information on current issues related to farming, new technology development for agriculture and farming, climate change and variability issues, as well as training about new agricultural techniques to counteract climate change and variability effects in farming.
- Lastly, extension agents need to provide market information and storage facilities for successful growth of farming enterprises in the study area.

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