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Socio-demographic determinants of access to climate change information among tomato growing farmers in Mvomero district, Tanzania

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Abstract

This study investigated tomato farmers' access to climate information in Mvomero District in Tanzania. This study used mixed approach where both quantitative and qualitative methods were used. The study comprised of 60 farmers' who were systematically randomly selected. Questionnaires, focus group discussions (FGDs), and in-depth interviews were the methods used in data collection. Quantitative data were analysed by using SPSS while content analysis was used for qualitative data. Key findings show that majority of farmers use radio as a source of climate change information. The study discovered that gender, marital status, age, level of education and income were the socio-demographic factors influencing access to climate change information. The study concludes that socio-demographic factors influence farmers' adaptation to climate change. The study recommends the establishment of ICT climate change information systems that can provide timely, relevant, and reliable climate change information to farmers. The study also suggests the use of mobile phone technology to reach out a wider population of farmers.

Keywords: Access, climate change, farmers, information, source of information, socio-demographic, use

Introduction

Climate change is a long-term change in the distribution of weather patterns over periods of time typically decades or longer with changes in mean and variability (IPCC, 2017; World Bank, 2008). Globally, climate is currently changing as a result of human activities which cause the release of greenhouse gases from fossil fuels (Guodaar, 2015; IPCC, 2017; Muema et al., 2018). Of late, Tanzania, like other developing countries, has witnessed recurring climate related tragedies such as flooding, severe droughts, livestock deaths, crop failures, demolition of infrastructures and escalation of climate sensitive diseases. Human development activities such as agriculture and industrialization have been reported to contribute to an increase of greenhouse

gases (GHGs) released into the atmosphere resulting in weather changes (IPCC, 2007). Climate change has affected food availability, tourism, wildlife, infrastructure, water scarcity, and resulted in displacement of people and continues to wreak havoc on people's livelihoods and communities. Climate change menace has thus severely affected livelihoods making it hard for most people, especially those in rural areas, to meet their basic needs (Muema et al., 2018)

In Tanzania, agriculture is one of the sectors which highly contribute to the GDP and employment opportunities to majority of people. Agriculture contributes an estimated 26.7% of GDP and is responsible for up to 40% of export earnings (URT, 2019). Most countries in the sub-Saharan Africa, including Tanzania, depend on rain-fed agriculture. Resultantly, the impacts of climate change in the Tanzanian agriculture sector include shifting in agro-ecological zones, prolonged dry periods, unpredictable rainfall, uncertainty in cropping patterns, and increased weeds, pests, and diseases (Paavola, 2003, URT, 2007). Climate change has in fact caused changes in the trend of precipitation where arid and semi- arid regions have become drier while other areas, especially mid to high latitudes, are wetter (Elia, 2013).

Horticulture farming in Tanzania has recently increased locally and internationally. Tomato also scientifically known as *Solanum lycopersicum (Lycopescon Esculentum)* is among horticultural crops from the *solanaceae* family widely cultivated in Tanzania. In the recent years, it has been found that tomato is highly affected by climate change and variability. As the crop is highly dependent on climatic conditions such as temperature, rainfall and water, effects brought by climate change have adverse effects to its production. In fact, although climate change affects crops differently, tomatoes are among the highly affected ones (Guodaar, 2015; Tshiala & Olwoch, 2010).

Information is one of the basic needs of human beings and societies' development largely depends on the availability and access to accurate and reliable information (Capstick, 2013). To effectively adapt to climate change and mitigate its effects, farmers growing tomatoes need to have access to timely and relevant climate change information. Farmers mostly access agriculture and climate change information through a number of ways. These include radio, mobile phones, television, village meetings, and extension workers. Access to and proper use of relevant and timely climate change information can promote farmers' adaptation to change effects and increase yields (Muema et al., 2018).

There are several factors that affect farmers' adaptation to climate change. These include, land, income, access to and sharing of relevant information, infrastructure, poverty, illiteracy, age, gender, level of education, and availability of labour (Maddison,2007; Brayan et al.,2009; Deressa et al,.2009; Cherotich, Saidu & Bebe, 2012; Muema et al.,2018; Dang et al.,2019). Others include access to extension services, technology adoption, household size, and access to credit (Adger, Arnell & Tompkins, 2005; Deressa et al., 2009; Bryan et al., 2009; Elia 2013; Abid et al., 2015; Guodaar, 2015; Coulibaly et al., 2017; Chandni et al., 2018; Muema et al., 2018; Li Dang et al., 2019). Factors such as industrialization and technology mostly affect developed countries while access to and sharing of relevant information, poverty, illiteracy, and infrastructure affect more developing countries (Elia, 2013). Despite an array of factors influencing farmers' adaptation to climate change, access to and use of reliable, relevant and timely climate information is still limited in most developing countries including Tanzania (Kalokola, 2015; Kahimba, 2015; Iwuchukwu & Udoye, 2014; Elia, 2013).

Globally, there are a number of studies which have been conducted on farmers' access to and use of climate change information (Muema et al., 2018). Similarly, various studies (Mtega,

2012; Kahimba, 2015; Elia, 2017) have investigated farmers' access to and use of climate change information. However, literature on this area remains limited, especially on access to such information among tomato growers in Tanzania. Understandably, literature on factors influencing access to and use of climate change information among tomato growers in Tanzania is scanty. In fact, there is insufficient number of recent studies that have statistically tested socio-demographic determinants of access to and use of climate change information among tomato farmers in Tanzania. This study, therefore sought to investigate the sources of information farmers use to access information on climate change and establish factors that influence access to information on climate change among farmers who cultivate tomatoes in Kipera village, Morogoro region, Tanzania. The study was guided by five hypotheses to statistically test the association between gender, marital status, age, education, and income with access to climate change information. The hypotheses are:

***H_1*:** Men have more access to climate change information than women.
***H_2*:** Married farmers access more climate change information than those not married.
H_3: The older the farmer is, the less access to climate change information.
H_4: Educated farmers access climate change information more than less educated ones.
H_5: Farmers with insufficient income have limited access information on climate change.

Literature review

This section constitutes three subsections. Sub-section one discusses sources of climate change, sub-section two explores farmers' access to climate change information and the last one describes factors that affect access to climate change information.

Climate change information sources

Information sources are crucial in informing farmers on proper ways to apply new knowledge to mitigate climate change. Lack of relevant information sources has been found to restrain farmers' efforts to increase agricultural outputs in rural areas (Mwalusaka, 2013). Improving the provision of appropriate climate information services to farmers can facilitate crop production and address their agricultural information needs (Mtega, 2012). The use of information sources differs between countries developed and developing countries. The difference is contributed to by the difference in advancements in technology, education, and infrastructure (Singh et al., 2016). Sources widely used by farmers to access climate change information in developed countries include television, internet, printed materials such as newspapers, magazines, professional organizations, and fliers (Muema et al, 2018; Elia, 2013). On the other hand, radio, colleagues, village meetings, mobile phones, and extension officers are extensively used by farmers in developing countries (Mtega, 2012).

Unlike farmers in developed countries, those in most developing countries prefer accessing climate change information from informal sources than formal ones (Singh et al., 2016; Oyekale, 2015). Preference of informal interpersonal channels is being attributed to farmers' keenness in learning agricultural related practices which can give them maximum returns. Rogers (2003)

observed that interpersonal sources were effective in changing farmers' strongly embedded attitudes, beliefs, and practices. The interpersonal sources in developing countries are preferred and trusted due to the nature of how societies interact and share information using word of mouth. The interpersonal sources are comparatively offer easy access to climate change information as farmers who are resource constrained, need to face less cost to access information. Mass media sources need higher initial cost to purchase equipment unlike oral sources.

Access to climate change information

Climate change information is crucial in farm decision making and adaptation (Ambani & Percy, 2012; Guodaar, 2015; Muema et al., 2018). It influences farmers' understanding, resources utilization, and development (Temel, 2007; Kahimba et al., 2015). Climate change information, therefore, is crucial in sustainable development as it enables agricultural stakeholders to address climate change challenges and help in meeting Sustainable Development Goals (SDGs) 1, 2 and 13. Access to climate change information offers scientists and farmers an opportunity to analyze the nature and scale of past, present, and future impacts of climate change (Ambani & Percy, 2012).

In Tanzania climate change information is mainly provided by government agencies, international organizations, and research and academic institutions (Kijazi & Reason, 2012). Although there have been remarkable efforts in disseminating information on climate change, farmers' level of access to reliable and timely information on climate change is still limited and far from ideal (World Bank, 2016; Dang et al., 2019). This is attributed to a number of factors including inaccessibility and inappropriate packaging of information. Additionally, technical, social, economic, and institutional factors have contributed to the problem (Elia, 2013; Mckune & Serra, 2016).

Access to climate change information by farmers is crucial in farm preparation and proper timing and planting of crops (Guodaar, 2015; Coulibaly et al., 2017; Dang et al., 2019; Ruth, Kashaigili & Majule, 2020). Farmers in most African countries, including Tanzania, access climate change information through extension officers, radio, television, village meetings and mobile phones (Deressa et al., 2009; Elia, 2017; Muema et al., 2018). Improved access to these sources can enhance usage of climate information for farm decision making (Muema et al., 2018).

Factors influencing access to climate change information

Despite efforts to disseminating climate change information to farmers, the level of utilization of the information to manage adverse effects of climate change is low (Serra & Mckune, 2016). Many factors affect access to weather and climate information by farmers (Singh et al., 2016). One of these is the lack of trust in and unreliability of climate change information (Dang et al., 2019). Lema and Majule (2009) noted that household use of climate information depends on trust placed on the forecasts. Mudombi and Nhamo (2014) found that to be used by farmers, climate change information needs to be reliable, trusted, and understandable. Also, effective communication is essential in making climate information usable in different contexts (Ambani & Percy, 2014).

Moreover, language, style, and type of media through which communication is done are essential factors that make climate information usable by farmers (Muema et al., 2018). The ability to access and make use of climate information varies significantly depending on the literacy and fluency in a given language (Ambani & Percy, 2014). Packaging of climate change information customized to specific users is crucial as it influences the usability of information (Kalokola, 2015; Elia, 2013). Similarly, lack of farmers' training on appropriate technologies and untimely repackaging of relevant information affect access to climate change information (Elia, Stilwell & Mutula, 2015). Furthermore, understanding information needs of diverse user groups may promote packaging of appropriate information on climate change in useful ways. Disseminating right climate change content to farmers may foster timely agricultural decision making and build strong partnerships between researchers, meteorology experts, extension officers, and farmers towards improving access and use of climate change information (Maddison, 2007; Deressa et al., 2009; Elia, Stilwell & Mutula, 2015).

Other factors that affect farmers' access to and use of climate change information include social status, social networks, culture, and the availability of communication resources (Adger & Brooks, 2003; Elia, 2013; Adger, Arnell & Tompkins, 2005). Also, socio-economic factors such as occupation, education, and income affect access to and use of climate change information (Mtega, 2012; Muema et al, 2018; Dang et al., 2019).

Methodology

The study applied an exploratory research design where quantitative and qualitative approaches were employed in collecting, processing, and analyzing data. The study was carried out in Kipera village in Morogoro region. Purposive method was used to select the study area based on prominence in growing tomato in the region. A total of 60 farmers who grow tomato were involved in this study. Simple random sampling was used to select the respondents. The method was used since it provides each case in the population an equal opportunity of being included in a sample (Singleton, 1993). Moreover, the study involved an extension officer and village leaders. The extension officer was identified from the district office while the village leaders were identified from the village office.

The study used questionnaires, focus group discussions (FGDs), and in-depth interviews to collect data. Questionnaires were distributed to 83 farmers and 60 were returned, giving a 72 percent response rate. Two FGDs sessions were conducted involving fifteen (15) farmers. The sessions comprised of eight (8) and seven (7) participants. The extension officer and village leader involved in the study was interviewed. The quantitative data collected from questionnaire were coded and summarised prior to analysis by using the Statistical Product and Service Solutions (SPSS). The researcher employed descriptive statistics, such as frequencies, percentages in data analysis. Qualitative data were analyzed using content analysis.

Findings of the Study

The section has three sub-sections which present results on respondents' socio-demographic characteristics, sources of information on climate change, and factors influencing access to climate change information.

Socio-demographic characteristics of respondents

The study sought to investigate the socio-demographic characteristics of respondents. In particular; gender, marital status, age, level of education and income of the respondents were the socio-demographic attributes of concern for this study as summarised in Table 1:

Table 1: Socio-Demographic Characteristics of Farmers

Variables	Frequency	Percent %
Gender		
Male	46	77
Female	14	23
Marital status		
Single	12	20
Married	47	78
Widowed	01	02
Age (years)		
16-24	20	33
25-34	24	40
35-44	14	23
>45	02	04
Education attainment		
No formal education	22	37
Primary education	11	18
Secondary education	27	45
Income		
High-income (> 10,000,000)	01	02
Middle income (5,000,000-10,000,000)	45	75
Lower income (5,000,000)	14	23

The findings show that majority (77%) of respondents were male. This implies that in the study area, more males are involved in tomato growing than females. Findings also show that majority (78%) of the respondents were married while 20% were single. Data on respondents' ages revealed that most (40%) were aged between 25 and 34 years, followed by 33% who were below the age of 24 years. Only a few (4%) respondents were above 45 years of age. The mean age of the respondents was 32.5 years. Age distributions of the respondents indicate that majority of tomato farmers were in the active age group. Results also indicate most (45%) respondents had attained secondary school education while 18% attained primary education, and 37% had no formal education. The results also indicate that majority (75%) of tomato farmers are middle income earners.

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Sources of Information on Climate Change

Respondents were asked to identify the sources used to access information on climate change. Results indicate that most (28.3%) farmers access climate change information through radio while few (6.7%) do so through village meetings, workshops, and demonstrations. See **Figure 1**.

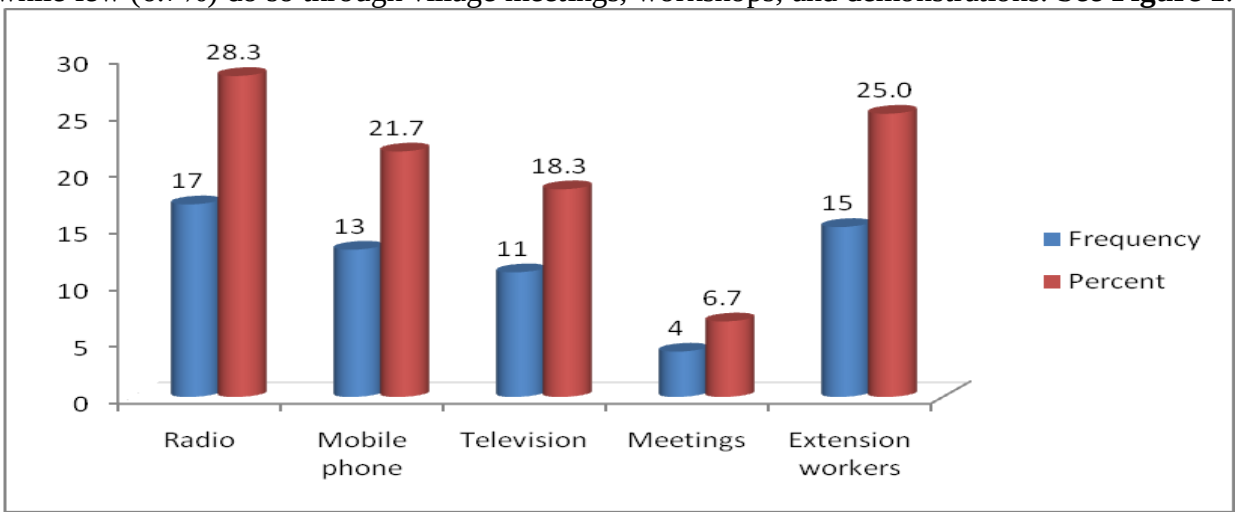

Figure 1: Farmers' source of climate information

Results from FGD supported these quantitative findings and indicated that farmers mainly access climate change information from radio, extension workers, meetings, televisions, neighbours, and family members. One FGD participant explained that "I mainly use radio to access climate change information. It provides very useful programs. I also at times consult my neighbours who grow tomato and extension officers." These results indicate that majority of tomato farmers' access climate change information disseminated through radio as compared to other sources. This is due to affordability of radio. This was also noted from one participant of FGDs who said that "ownership of information sources like radio, television sets and mobile phones depends much on one's level of income".

Association between socio-demographic factors and access to climate change information

The study investigated the relationship between access to climate change information and selected socio-demographic factors. Gender, marital status, age, education level and income were the demographic factors tested for association with access to climate change information. Findings indicate an association between access to climate change information and these factors. Table 2 summarises the findings.

Table 2: Chi-Square Test between Gender, Marital Status, Age, Education level, Income and Access of Climate Information

Category	**Access of Climate Change Information**		
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square			
Gender	11.440[a]	2	.003
Marital status	18.980[a]	4	.001
Age	30.355[a]	6	.000
Educ. Level	21.097[a]	4	.000
Income	17.429[a]	4	.002
N of Valid Cases	60		
Probability level = 0.05			

Regarding the influence of marital status, it was learned during an in-depth interview with an agriculture extension officer that married couples are more dedicated to new agricultural information compared to those who are single. Findings from FGD indicated that eleven out of fifteen participants acknowledged that age is a key factor in productivity and profitability farming. They assert that young farmers are more likely to adopt new technologies that aim to counter adverse effects of climate change because of their capability and readiness to seek and access multiple sources of agricultural information. Furthermore, in-depth interview with the agriculture extension officer revealed that younger farmers are more reactive and responsive to adverse effects caused by climate change compared to older ones. Along that, it was learned during the interview that currently, school curricula include environmental subject matter focusing on global climate change. Such content enhances young graduates' awareness and understanding of climate change.

Regarding the role of education, one participant of FGDs commented that "farmers with formal education regularly access climate information from different sources compared to farmers without such education". In support of this, the interviewed extension officer revealed that farmers' ability to comprehend various agronomic practices attached with climate and weather forecasts increases with education level. The officer emphasized that education enhances understanding of agricultural best practices for countering adverse impacts of climate change through proper assessment of climate information.

The findings have also revealed the influence of household income on access to climate change information. According data from the interview session with the extension officer, farmers with high incomes have increased capacity to adapt to adverse effects of climate change. This is because financial capacity determines one's ability to acquire and manage resources for seeking and applying information on climate change.

Discussion of the findings

This section discusses sources of climate change information and factors influencing access and use of the information.

Sources of information on climate change

Results have indicated that majority of farmers access climate change information through radio. Although farmers use radio more, other sources such as mobile phones, televisions, meetings, and extension workers are used for this purpose. Access to information on climate change through radio has been linked to low cost, low maintenance cost, and wide coverage (Oyekale, 2015). Tomato farmers prefer radio to access information on climate change compared to other sources because of its affordability, availability, and accessibility (Muema et al, 2018; Singh et al., 2016).

Unlike television and some mobile phones, radio is cheaper to purchase. Radio use also allows farmers to continue getting information even when on the move. This offers them convenience since most of their time is used on farm duties. Moreover, as most farmers in Tanzania practice subsistence farming (Elia, 2013), they experience resource constraints, thus lacking sufficient funds to purchase other information sources and gadgets which could provide them with climate change information. As such, they resort to radio as they can easily access the information disseminated at a minimal cost. Furthermore, farmers also mostly use radio as it is a trusted source because most information communicated is from reliable sources.

Lack of proper infrastructure such as electricity in rural areas and initial cost required in purchasing equipment such as television and Smartphone could hinder farmers from using other tools to access climate change information. Although most studies (Singh et al., 2016; Muema et al, 2018) have reported the preference of radio among farmers with low literacy levels, the current study findings surprisingly indicate that radio is preferred by both farmers with low and those with fairly advanced literacy levels. Similar to previous studies (Lwoga, Stilwell & Ngulube, 2011; Lema & Majule, 2009), results of this study show that the information seeking behaviour of farmers in developing countries is being influenced by a number of factors such as income and level of education.

Findings also indicate farmers' preference of extension officers as a source of climate change information. This preference is attributed to the fact that extension officers are a sources relied on by most farmers for reliable information on climate change. However, these sources have been reported to be mostly inaccessible to farmers. Challenges farmers face in accessing extension officers have been linked to insufficient government budget allocated to extension services (Lema & Majule, 2009).

Results of this study further show that farmers used multiple sources to access information on climate change depending on qualities of information such as understanding, relevance, usability, and type. Use of multiple information sources could explain the uncertainty with, understanding, and trusting of climate change information. Singh et al (2016) indicated that climate change information is difficult to comprehend and uncertain. This probably explains the

behaviour of most tomato farmers who seek information from multiple sources to meet their needs.

These findings also show that fellow farmers and friends were sources of climate change information for tomato farmers. There are two factors that can be used to explain this information seeking pattern. One is the inaccessibility of extension services. As such, fellow farmers present a viable option when information on tomato farming and climate change is needed. Lack of extension services is one of the factors that hinder farmers' access to and use of information on climate change (Muema et al., 2018).The other factor is the inability of farmers to own information and communication tools.

Besides, the researcher noted that majority of farmers' posses' mobile phones. Based on the current findings, five (5) FGD participants owned smartphones while ten (10) had regular mobile phones. However, even the respondents that owned smartphones indicated that they do not access climate change information through these. Two factors could have contributed to this state. One is lack of awareness on the opportunities presented by these devices and skills needed to use them. The second one could be farmers' inability to purchase mobile phone bundles. In general, the use of smartphones can enable farmers to receive timely and relevant climate change agro-advisory services to improve productivity (Singh et al, 2016).

Social- demographic factors and effects on access to climate change

The study investigated the association between socio-demographic factors and access to climate change information. Specifically, gender, marital status, age, level of education, and income were the demographic factors tested and discussed in subsequent sections. The themes presented are based on the five hypotheses tested.

H_1: Men have more access to climate change information than women

This study assessed the relationship between farmers' gender and access to climate change information (see hypothesis 1). Results from chi test (see Table 2) revealed a statistically significant association between gender and farmers access to climate information. The findings imply that access to information on climate change is influenced by farmers' gender. The results therefore imply that although fewer women were involved in cultivating tomato, majority of them were informed on climate change. This can be attributed to a fact that most women in developing countries communicate through peers social networks (Singh et al, 2016). Oral communication is a type of interpersonal communication which has been found to influence awareness and adoption of new agricultural knowledge (Rogers, 2003; Elia, 2013).

Findings were also surprising as despite women mostly engaging in agricultural farming compared to men in Africa (Daudu, Chado & Igbashal,2009; Dang et al., 2019), they do not adequately engage in cultivating economically profitable crops (Lema & Majule, 2009; FAO, 2015). Men in rural areas tend to have more resources and assets such as radio and mobile phones compared to women (Coulibaly et al., 2017). Thus women tend to have more access to extensive information from sources such as radio. However, men dedicate little time in family affairs such raising children, cooking and housekeeping when compared to women (Hampson et al., 2014). Although current results indicate men could be having more resources and financial capabilities as they dominate tomato farming, it would have been assumed that they will use the

income to improve tomato cultivation by accessing extensively information on climate change through different sources. The current findings however do not reflect and attest such an assumption. The results thus demonstrate access to climate change information is not necessarily influenced by gender and power dynamics at family level.

H_2: Married Farmers Access more Climate Change Information than those who are not married

This study further examined the relationship between farmers' marital status and access to information on climate change (see hypothesis 2). Results (see table 2) revealed a statistically significant association between marital status and farmers' access of climate change information. The findings imply that; marital status has a significant influence on farmer's access to climate change information.

There are several reasons which could explain the observed relationship. One is most farmers in developing countries like Tanzania practice communal farming where members of the family are involved. As such, farming and productivity tend to be influenced by the composition and size of the family (Igben, 1988). Married couples may have more contacts from the husband, wife and children; increasing chance of accessing more information. The social networking of married farmers positions them to meet more contacts who can influence information and knowledge acquisition. Thus, married farmers can have a wider access to climate change information sources compared to those who are not married.

The marital status also shapes the farming and information seeking behavior of farmers as married farmers tend to be committed (Singh et al., 2016) and highly engaged in farming and seeking of information than those who are not. Since married farmers in developing countries usually have extended families, (Deressa et al., 2008) each family member presents a potential information source. The study thus confirms the effect of marital status on farmers' access to relevant information on climate change.

H_3: The older the farmer is, the less can access climate change information

This study examined the relationship between farmers' age and access to climate change information (see hypothesis 3). Results (see table 2) indicate that a significant association exists between access to climate change information and farmers' age. These findings imply that, farmer's access to information on climate change is influenced their ages. Younger farmers seem to have more sources and networks from which to access information on climate change than older ones. Young farmers are also quick adopters of technologies and perhaps users of information disseminated from technological sources. For instance, Chandni et al (2018) and Dang et al., (2019) showed that young farmers are more energetic and earlier adopters of new technology compared to old ones who are typically late or laggards. Cherotich, Saidu &Bebe (2012) also found youths to be better users of ICTs more compared to the elderly. In the context of this study, young farmers actively seek and use agricultural and climate related information to increase crop yield and generate more income. Moreover, as findings indicate, younger farmers

use mobile technologies to access climate change information. With the increase in mobile phones and internet users in Tanzania (Media Council of Tanzania, 2018), farmers have better platforms to access climate change information from.

Moreover, younger farmers' access to climate change information could also be attributed to changes in the curricula of primary and secondary level of education (Paavola, 2004). The revised curriculum informs students on different issues related to the environment. As such, young farmers are likely to be aware of climate change.

H_4: Educated farmers access climate change information more than less educated farmers

This study also tested if there is any statistical association between farmers' use of climate change information and level of education. Results (see table 2) indicate a significant association between farmers' level of education and access to climate change information. These findings imply that farmers' access to climate change information is influenced by their level of education. Similarly, a study by Cherotich, Saidu and Bebe (2012) noted that farmers' level of education determines access to and use of climate change information. The United Nations Framework Convention on Climate Change (UNFCC) (2017) noted that education is a powerful instrument for combating climate change. Qualitative findings also support the relationship between level of education and access to climate change information. Education helps farmers in a number of ways with regard to accessing and using climate change information. This includes helping tomato growers to understand the extent of climate change menace and seek adequate measures to apply to ensure harvest and increase production.

H_5: Farmers with insufficient income can less access information on climate change

Moreover, this study examined the relationship between farmers' income and access to climate change information (see hypothesis 5). Similarly, the results indicate a significant association between access to climate change information and farmers' income. These results imply that, farmers' income influences their access to climate change information. These results are consistent with those reported by Mtega (2012) and Elia (2013) on information provision and usage. Farmers' with a good income can strengthen their climate change adaptive capacity by adopting proper and user-friendly coping and adaptation measures. Such measures can include user friendly farming technologies, diversifying economic activities, developing irrigation schemes, and cultivating high yield varieties. Thus, income facilitates better access to climate information which enables farmers' to proactively plan for adaptation measures against adverse effects of climate change (Muema et al, 2018).

Conclusion and recommendations

Developing countries still face challenges in their addressing of current and future climate change impacts. Key barriers in accessing climate change information include inaccessibility to of relevant and reliable information. Despite the progressive investments in the provision of climate services to farmers in Tanzania, there still remains a disparity between information disseminated to farmers and their needs. This study concludes further that despite access to climate change information being affected by a number of factors, marital status, age, education,

gender, and income seem to have a significant effect. The implication is that, in order to promote adaptation to climate change so as to improve yields and maximise profits of tomato growers, more investment should be dedicated to dealing with the effects of these variables. The more stable families are, the more they can access multiple sources and effectively adapt to climate change. Moreover, the more educated farmers are, the more they can cope and adapt to climate change. The study also concludes that farmers with stable income can perhaps have better access to climate change information sources and adapt to climate change better than those who earn less. It is further concluded that farmers who grow tomato are youths who can effectively seek, access and use climate change information compared to older farmers. The study therefore recommends needs assessment to be carried out among the farmers in order to establish their information needs. Based on the information needs to be established, information to be disseminated to farmers should be prepared appropriately. In addition, farmers should attain formal education and frequently update their knowledge on proper farming practices that address changes in climate. The study also suggests that female farmers should be empowered with access to timely and relevant information to increase their engagement in tomato cultivation. It is also recommended that change from conventional information dissemination pathways to new channels which use information and communication technologies and internet should be done.

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