

Assessment of Climate Change Adaptation and Resilience Through Trade in Kyela District, Tanzania

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Abstract

The impacts of climate change has been viewed as a threat to various economic sectors with agriculture being the most affected than other sectors. This forced households to respond in different ways including participation in trade to minimize and resist their impacts. While various studies have reported on different ways of climate change adaptation through agriculture, the assessment of trade related adaptation techniques is inadequate. This necessitated the need to understand the role of trade in adapting to climate change in Kyela district. The paper studies trade as one of the strategies used by rural households to reduce the risks and uncertainties of climate change while sustaining the resilience of their livelihoods. Data were collected through documentary review, household interviews, focus group discussions (FGDs), key informant interviews (KIIs) and field observation. The qualitative data and the quantitative data were analysed by content analysis and Package for Social Sciences (SPSS), respectively. The results show that households are aware of climate change and have involved in trade as one of climate change adaptation strategies in Kyela district. Trade has improved access to new and clean technology, the required goods and services for adaptation and updated climate information, which consequently lead to improved resilience among households. The study recommends that the government should encourage high participation in trade and improve rural markets to provide equal opportunity for participation and profitability through trade which is essential for both improved livelihoods and resilient agricultural production.

Keywords: climate change, trade, adaptation, Kyela district, Tanzania

1. Introduction

The impacts of climate has been viewed as a threat to various sectors of the economy including agriculture, tourism and trade. The impacts of climate change are already experienced by both rural and urban residents. For instance, there are impacts such as extreme weather events, land degradation, loss of biodiversity and rising sea levels which has risks to human health and survival, food supply and livelihoods, public goods such as access to water, and to migration and displacements (Allen et al., 2019; GCA, 2019). The agricultural sector is one of the most affected sector due to increased frequency and severity, and the shifts in climatic patterns particularly temperature and precipitation. Agriculture has become a risky activity due to stresses caused by increased droughts, shorter rain seasons and increased incidence of pests and diseases that lead to declining agricultural productivity (Ahenkan et al., 2020; Mensah et al., 2020; Kalinga et al., 2022). Further, due to climate change impacts such as flood, the trade

related infrastructures such as markets and transport services have also been adversely affected. For instance, in rural remote and marginalized societies are likely to be the most affected by climate change due to destruction of infrastructures caused by floods that inhibit the linkages with urban centres (Kalinga et al., 2019; Brenton and Chemutai, 2021). The climate change impact are not only influencing farmers but also the consumers who rely on agricultural products for food as well other actors in the value chain of various crops (IPCC, 2019). Unfortunately, it has been increasingly recognised that the impacts of climate change is expected to worsen in the coming years (Kalinga et al., 2022; Mavhura et al., 2021; Martey et al., 2021), which has implication on societal livelihoods in general. This draws more attention on climate change perception and adaptation mechanisms.

Several studies reported about climate change adaptation through agricultural production such as the participation in diversity of activities such as trade and wage labour and crop diversification (GCA, 2019). In Tanzanian, farmers have adapted through growing a combination of crops, the adoption of improved seeds, the use of drought tolerant crops and irrigation farming so as to reduce the climate related shocks on their agricultural production (Kalinga, 2021; Komba and Muchapondwa, 2015).

While various researchers documented on the climate change adaptation through agricultural production, others have provided a discussion on the climate change adaptation through trade and markets. For example, a study by Alston and Akhter's (2016) reported that market enables households to obtain food requirements than relying on their produced products. Trade plays a significant role as it provides various goods to regions with reduced local production caused by climate change. This reduces the negative impact of climate changes while promoting transformation of agricultural sectors which enhances resilience among rural societies. Markets provide opportunities for trade among various regions which allows to reduce the shocks of climate change while benefiting from comparative advantages between different regions (Remans *et al.*, 2014).

Further, other studies documented that trade is one of the causes for climate change due to its impact on increasing GHG emissions. For instance, a study by Cristea *et al.* (2013) reported that trade has contributed to emission of greenhouse gas (GHG) through transportation activities and by its impact on the location and scale of production and consumption of various goods and services, as well as through technology transfer. Although trade has found to lead to increased GHG emission, but it is also evident that trade is significant in climate change adaptation and in sustaining the resilience of rural farmers. This is because Trade forms a critical part of adaptation towards climate change through transferring cleaner production methods from one location to another and facilitates the distribution of various goods and services, which helps in recovery from vulnerable condition caused by climate change (Brenton and Chemutai, 2021). Also, trade encourages investments in climate-resilient infrastructures such as energy, transport and telecommunication infrastructures that promotes economic diversification among rural communities for attainment of reliance on agricultural sector (GCA, 2019).

This study focuses on the role of trade on climate change adaptation in Kyela district, Tanzania. Although there is a wide literatures on various adaptation strategies, still there is inadequate information on how trade helps in adapting to climate change. This study fills this gap through assessing the community's perception on climate change and the ways of adaptation through trade with the case of Kyela district. This is because adaptation strategies varies from one area to another based on the knowledge, nature and perceptions of a particular society (Mavhula et al., 2021). Also, for efficient climate change adaptation, any strategy requires the consideration of location specific perception and development necessities as well as existing capacity of the community to address climate change and variability impacts (Brenton and Chemutai, 2021). Therefore, a more understanding on climate change adaptation is significant to identify various opportunities and potentials of profitability through adaptation which consequently, improves the resilience of livelihoods among rural households (Jiri and Mafongoya, 2018). This raised interest to assess the trade related adaptation strategies in Kyela district, Tanzania so as to identify different strategies that could be captured as opportunities for rural development.

Therefore, this paper responds to questions on what is the perception of the local community on climate change, and what is the role of trade on adaptation to climate change in Kyela district. This paper contributes to the theory of comparative advantages and add to existing body of knowledge on the role of trade on climate change adaptation among rural societies.

Theoretical framework

This study is guided by the theory of comparative advantages which supports that through trade, food scarcity areas can be compensated with food surplus areas. Markets responds towards various situations like changing climate, technology and resource endowments and other disruptions as they compensate losses from climate change impacts (Baldos and Hertel, 2015). Hence, the theory is used in this study as a starting point for promoting climate change adaptation through participation in trade for realisation of resilient livelihoods among rural communities.

After an introductory section, the remaining part is organised as follows. Section 2 presents the study area and the methodologies used. Section 3 presents and discusses the study findings that covers about various issues related to communities' perception on climate change and the trade related climate change adaptation mechanisms. The final section gives the conclusion and recommendations of the study.

2. Methodology

This study employs a descriptive research design that allowed to collect data from trade related climate change adaptation methods. Both, the quantitative and qualitative approaches were applied in this study to their ability to improve the validity of data (Almalki, 2016). Information was collected through multiple sources such as documentary review, household interviews, focus group discussion (FGDs), key informant interviews (KIIs) and field observations so as to reduce the chances of bias, while improving the research validity (Denzin & Lincoln, 2018).

The study was carried out at Kalumbulu market in Kyela district, Mbeys region, Tanzania. With the help of regional officials purposive sampling was used to select Kyela district because it is one of the districts impacted by climate change and where households largely depend on rain-fed agriculture. Also, through a purposive sampling procedure the district officials helped in selecting the Kalumbulu market which is located in Kyela ward because it is one of the famous area for collection, storage, milling and marketing of paddy. The rice mills machines are concentrated in the area and has attracted various individuals and groups of people of Kyela district to be involved in rice trade. At the Kalumbulu market with the help of marketing officers and ward officials purposive sampling was used to select traders who were paddy producers in Kyela district. Therefore, at the Kalumbulu market a total of 78 rice traders were interviewed for this study.

A combination of both primary and secondary data were collected in this study. Secondary data were collected through a documentary review while the primary data were collected through household interviews, FGDs, KIIs and field observations. In depth key informant interviews were conducted to village chairpersons and executive officers as well as agricultural extension officer and marketing officers. Also, the ward executive officers, the district officials, leaders of various associations like drivers, rice producers, traders, elders and religious leader were interviewed. Further, the three focus group discussions (FGDs) were held separately for women, men, and youth. The use of KIIs and FGDs had the purpose of gaining an additional information about changes in climate and adaptation ways applied in the area. The qualitative data were analysed using content analysis while the quantitative data were analysed by SPSS and Excel spreadsheet. Also, trend analysis was used to analyse changes on climate overtime.

3. Results

3.1 Perception of the local community on climate change

The occurrence of changes in climate has become one of the major global issues of interest among various scholars. This study focuses on the climate change perception from 1989 to 2020, particularly in terms of rainfall data. The respondents were asked to make a comparison on climate based on the average rainfall and its variation overtime between the climate of the 1990s and that of 2020. About 78% of respondents indicated that they are aware of climate change and have adopted various adaptation strategies to reduce their impacts. Trough FGDs and KIIS it was reported that the area has experienced changes such as short rain season, flood, long drought period and changing patterns of rainfall overtime. This implies that community in Kyela district have recognised and felt the changes that have occurred in the area. Also, the changes in climate was verified by the rainfall data that were provided by Tanzania Meteorological Agency (TMA) at Kyela-Bomani station which revealed that the climate change is real in Kyela district. There were variation in rainfall overtime from 1989 to 2020 (Figure 1).

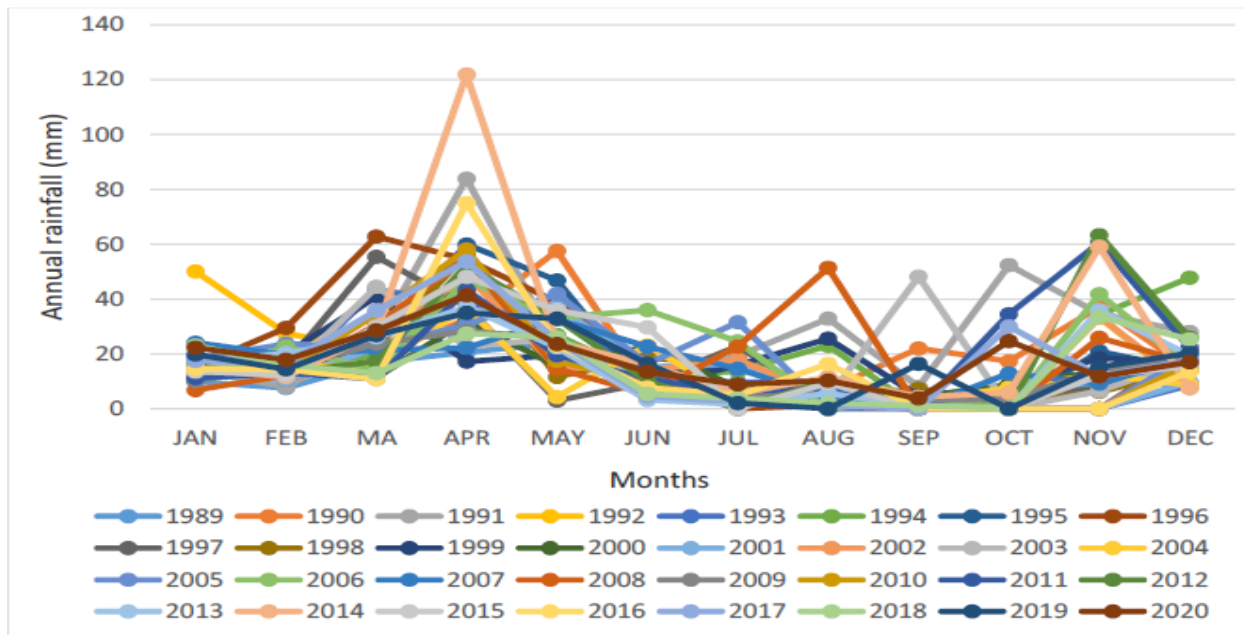


Figure 1: Climate Data on Annual Rainfall (Mm) From 1989 to 2020
 Source: Tanzania Meteorological Agency, Kyela-Bomani Station.

The 31 years period from 1989 to 2020 was grouped into three decades to simplify an understanding of the changes occurred in climate in terms of rainfall. The findings show that for the period of three decades from 1989 to 2020 the annual rainfall have fluctuated overtime (Figure 2).

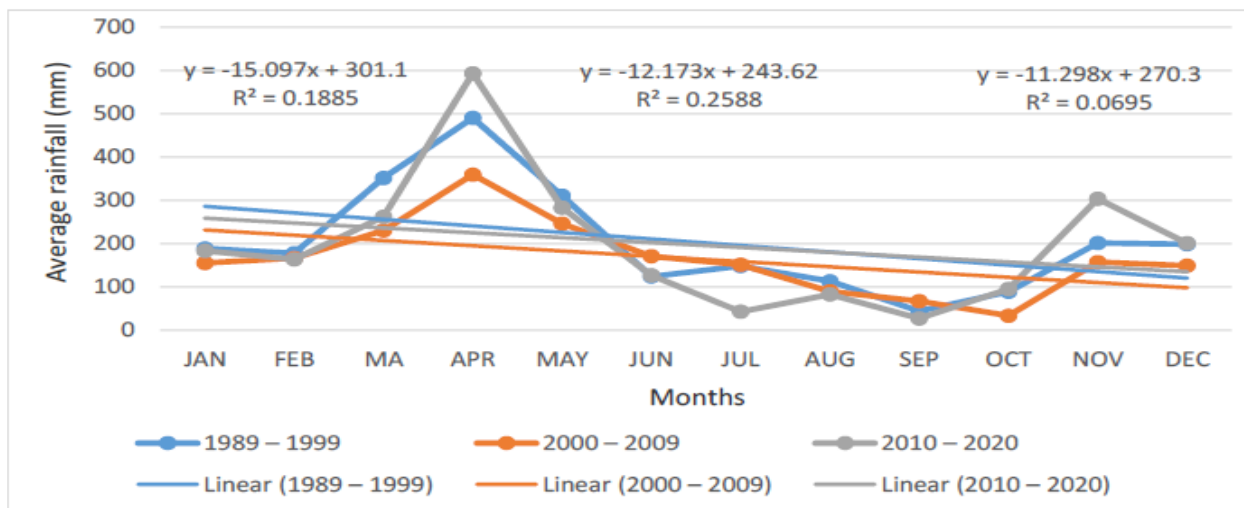


Figure 21: Annual rainfall (Mm) by decades from 1989 to 2020
 Source: Tanzania Meteorological Agency, Kyela-Bomani Station.

The results presented through equations and by regression lines (Figure 1) illustrates that the annual rainfall decreased by the rate of 19% (0.1885), 26% (0.2588) and 0.7% (0.0695) for the period from 1989 to 1999, 2000 to 2009 and 2010 to 2020, respectively.

$$y = -15.097x + 301.1, R^2 = 0.1885 \text{ (1989 – 1999)}$$

$$y = -12.173x + 243.62, R^2 = 0.2588 \text{ (2000 – 2009)}$$

$$y = -11.298x + 270.3, R^2 = 0.0695 \text{ (2010 – 2020)}$$

The three equations for three decades indicate that there was a decreasing trend in annual rainfall but the decrease was not significant. This is because the R^2 value, which is the coefficient of determination was below 0.5. Despite that the results from regression analysis indicates that the changes were insignificant but the FGDs and KIIs revealed that their impacts on households' livelihoods was significant as it led to increased droughts periods, shorter rain seasons and increased spread of incidence of pests and diseases that lead to declining crop productivity. This made households to respond in different ways including trade, in order to reduce their negative impacts. Trade was viewed as the main alternative because it compensates for the losses occurred from crop farming caused by climate change.

3.3 The role of trade in climate change adaptation

Trade has emerged as one of the climate change adaptation strategies in Kyela district. Participation in trade enabled farmers to adapt to climate change through various ways including access to new technology, access to climate information, alternative income source, food availability from other locations, access to farm inputs and improved social network (Figure 3).

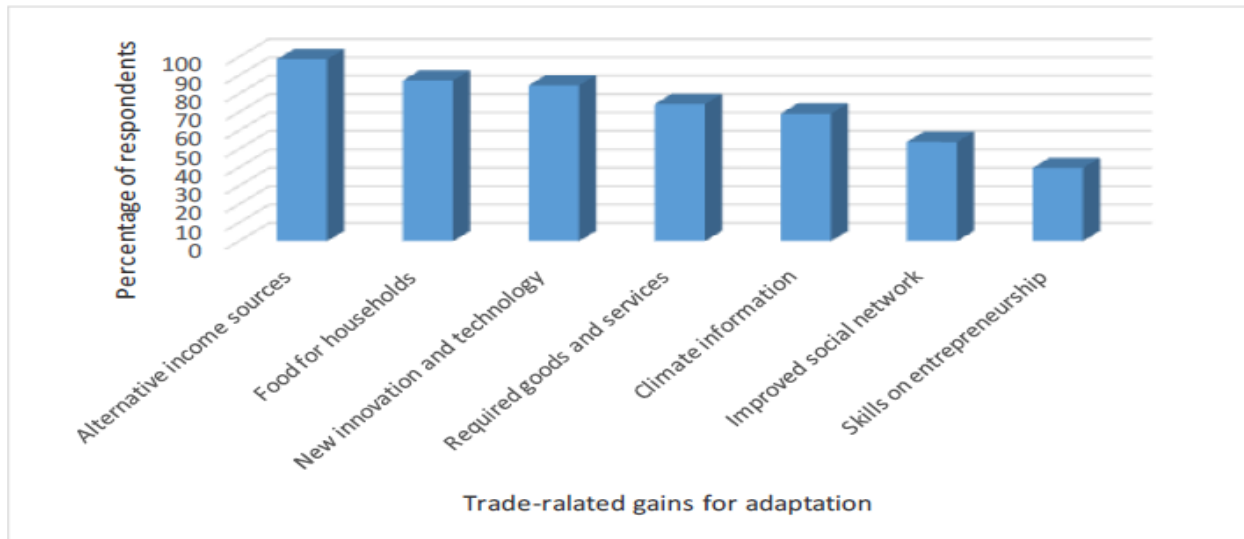


Figure 3: Trade-related gains for adaptation
Source: Field Data (2021)

3.3.1 Access to alternative income sources

Despite that agriculture has remained the main occupation among rural communities, trade has emerged to be one of major alternative source of income for the majority of rural populations. When asked about the climate adaptive gains obtained from trade the majority of respondents (98.7%) indicated that trade was their major alternative income source in the area (see Figure 2). It was also revealed through FGDs that trade was used as a part time activity for the majority of farming household members in the district as it is vital in generating additional income for family members. One of the group participant argued that;

“Despite the reality that agricultural production is the main source of income for our families but trade is very important because it used as a part time activity that generates a quick cash income for solving immediate and critical needs for money”. (A female rice trader aged 46 at Kalumbulu market, December, 2021)

The presence of rural markets created opportunities for farmers and encouraged them to participate in trade so as to maintain and sustain their income in the changing climatic condition. It was reported by FGDs and KIIs that trade has provided various opportunities including jobs essential for raising household income which consequently improves resilience among farmers. Despite that climate change has led to reduced income due to crop failure caused by extreme climatic events, households remained resilient due to emergence of other income sources in the area particularly, trade which was observed to be important income source for satisfying various requirements of households including purchases of food and cloths, purchasing farm inputs as well as payment for health and education services.

3.3.2 Access to food for households

Trade is considered to be important in promoting food availability and food access to citizens in various countries. About 87.2% of respondents declared that trade was important in ensuring food availability for their households particularly in the face of climate change. Traders have traded within and outside the districts as well as trading with other traders from distant locations. This created the comparative advantages which are opportunities with potential for food from other locations. KIIs and FGDs reported that trade contributed to food availability in rural markets where farmers can easily access them. Climate change impacts resulted in to changing production patterns where a particular region may have ability to produce more food than other regions or may be able to produce crops different from those produced by others. Therefore, through trade there is distribution of food from one location to markets in another location. This enables different region to access food not produced by its households. This compensates for the loss occurred due to climate change. For example, traders from Rungwe district brings products like bananas, maize, round potatoes and vegetables to Kyela districts while taking in Kyela goods such as rice, sugar (made from Malawi) and cooking oil made from palm oil. This was also confirmed by field observation where traders from outside the district were taking products available at markets in Kyela district and go for resale in other markets. This indicates that with trade the comparative advantaged can be easily realised because food distributed from food

surplus to deficit areas becomes possible, that guarantees food availability in various location, which consequently, ensures food securing in the area. Traders in Kyela district traded with traders from other regions such as Dar es Salaam, Morogoro, Iringa and Dodoma as well as other countries like Malawi, Zambia, Congo DRC, South Africa and Dubai, which enable household to remain stable and resistant to climate change impacts due to opportunities obtained from trade. Trade relations with other countries indicates that there is integration of Kyela district into global economy. This facilitate sharing of products and technologies as well as information about climate change which is required for adaptation.

3.3.3 Access to new innovation and technology

The study revealed that through trade many households (84.6%) obtained access to new innovations and technologies such as the use of improved seeds, the drought resistant crops, herbicides and fertilisers so as to improve crop productivity. This promoted improved food availability because improved seeds matures for a short time than the traditional ones while the use of drought resistant crops can tolerate the periods of long dry season which ensures food supply in the area. Also, the use of herbicide was significant because it encouraged minimum tillage which is important in climate change mitigation as it reduces the amount of carbon to be exposed into atmosphere which enhances carbon sink in the area. This indicates that participation in trade provided opportunities of new technologies for adaptation which provides potentials of improving crop productivity for maintaining food security in the area. The adoption and use of herbicide is an indication that through trade clean technologies can be adopted and spread to other areas which reduces the GHG emissions. This is because herbicides are essential on enhancement of soil organic matter through reduced or zero tillage and reducing emissions into the atmosphere while improving the carbon sink. This shows that trade is very significant as it can speed up the spread of new and clean technologies of adaptation from one area to another while enabling access to the majority of farmers.

3.3.4 Access to required goods and services for adaptation

The study revealed that trade enabled access to proper goods and service essential for climate change adaptation as indicated by 74.4% of respondents. This indicates that participation in trade enabled them not only to access income but also goods and services for adaptation. For example, the adoption of improved paddy varieties known as Saro five was accessed from markets. Also traders have acquired various goods such as raincoats and gumboots as well as umbrellas which are useful during rainy season. Further, the FGDs indicated that through trade they have obtained consultation services from business men in issues related to agricultural development. For instance, there are groups of traders specialised in service provision who sell products and services on application of a particular inputs like herbicides, insecticides and pesticides, which enables to apply the inputs in a good manner while reducing the impact of climate change and variability impact.

3.3.5 Access to climate information

Access to information is important in the process of decision making where with sufficient information farmers may decide whether or not to adopt a particular innovation or to grow certain types of crops. About 69.5% (see Figure 2) of respondents declared that they have accessed various climate information through trading activities. Making efficient choices of what crops to produce based on the existing climatic conditions is essential because climate determine the correct crop variety to be grown in the area. Access to updated information on climate change and their associated adaptation mechanisms enable households to transform their agricultural production for improving and sustaining their livelihoods. Also, the agricultural transformation has implication on economic growth of rural societies in general.

Also the FGDs and KIIs reported that trade was important in obtaining updated information on climate change and their associated adaptation practices. The awareness creation on climate information enabled farmers to focus their farming on crops that helps in adaptation process such as decision to use improved seeds that copy with climate change situation than relying on traditional varieties. The use of mproved seeds are considered to have good results in terms of quality and quantity harvested per area. Also, sufficient information enable rural societies to shift their growing season depending on the shifting rainfall patterns, accordingly.

Other trade-related benefits for adaptation included improved social network and gained knowledge on entrepreneurial activities as indicated by 53.8% and 39.7% of respondents, respectively. Improved social network was important on the provision of information and improving the linkages between Kyela district and others areas both within and outside the district while entrepreneurial skills are important in performing various activities including processing of crops which improves crop values and their durability status.

4. Discussion

The study supports the comparative advantage that trade enables household in different locations to enjoy the regional proportional advantages from one another. Through trade the producers and consumers of different locations are able to share the comparative advantage which helps to reduce the negative impact of climate changes (GCA, 2019). The theory of comparative advantages suggests that through trade, areas with food deficit can be compensated with areas with surplus food. Trade appears to be a strategy towards various food challenges including those related to climate change impacts. Through markets, traders help to reduce risks and shocks resulting from various situations such as climate change, change in technology and other disturbances (Baldos and Hertel, 2015). The availability of traders from other district and other regions as well as other countries is an indication that comparative advantages are enjoyed by the society both within local markets and global markets.

The availability of traders and products from other district and other regions, as well as other countries is an indication that the essence of the comparative advantages have been realised. This is very useful in solving various food challenges between food surplus and deficit areas which consequently lead to improved resilience among households. This positive outcome is consistent

with various studies which show that participation in trade provides access to various strategies useful for adaptation. For instance, a study in Kahama district, Tanzania, by Ngongi and Urassa (2014) reported that participation in trade enabled households to have alternative income sources that improves household income and compensate for the declining income from agriculture. Similarly, a study by Timmer (2017) reported that the involvement in business activities ensures access to household income throughout the year because trade is less attacked by climate change when compared to agriculture, which helps to sustain food security for households. Further, a study in Southern African shows that through participation in trade, the impact of drought condition of 2015–2016 became reduced by moving food from areas with surplus to areas with food deficit to meet the food needs in the area (CGA, 2021). These studies are in line with Ogueno *et al.* (2017) who reported that rural households are encouraged to consume the purchased foods than depending on what is produced by their families. Also, these results agrees with Racaud (2017) who suggests that through trade, products such as banana and round potatoes from Rungwe district have reached different countries including Zambia, Malawi, Congo DRC and Botswana, which also acknowledge that the comparative advantages are shared by different areas and that rural areas have become incorporated into both national and international economies. In addition, the findings by Mainet and Racaud (2017) emphasis that trade is important in linking rural areas and urban markets as well as integrating rural to global markets that improves food security for households while promoting transformation of agricultural sectors and economic diversification among rural societies.

Furthermore, access to new innovation and technology was found to be of great achievement because they resulted not only into improved crop productivity but also in mitigating the climate change. The role of the new innovation and technology was also reported by other scholars. For example, a study in African Mountain Regions by Racaud (2017) highlighted that trade promotes access to various inputs such as animal feed and veterinary products which are important for enhancement of food supply. Also, Ollenburger *et al.* (2019) emphasised that through trade households have adopted intensified agriculture that reduces crop stress resulting from climate change. Through trade, various inputs and agricultural machines are distributed to various locations close to farming households for improving farmer's access to such inputs for attainment of high yields (Lehikoinen, 2021). These results are in line with findings by Zimmermann (2018) that the new innovation on agriculture is significant as they have a positive outcome on climate change mitigation. This is due to the fact that trade encourages the transfer of the new technology while promoting its distribution to various parts of the world, hence playing a great role of mitigating climate change worldwide in general.

Moreover, the results show that trade was important in accessing information that helps in adoption of relevant and coordinated responses against climate change impacts in various localities. For instance, the adoption of relevant goods and services helps to reduce panic and stress among local communities while making them resilient farmers with sustained livelihoods. This is because climate information are useful in monitoring and improving goods and services that are required for adaptation (Brenton and Chemutai, 2021). Similarly, a study by Adams *et al.* (2021) reported that traders are important actors in crop value chain because through their social

networks they allow dissemination of climate information necessary for adaptation. These results agrees with observation by Dekens (2021) that access to information on goods such as the drought resistant varieties and special clothes with special materials to can be achieved through trade. The climate information is significant due to the fact that they can be applied in decision making on investments required in products and services that can lead to reduced risks and uncertainties associated with climate change. This will promote establishment of related transnational collaborative approaches in promoting climate change adaptation and resilience between and among global societies in general. Trade seems to be a strategy for decreasing risks of climate change through reducing troubles and uncertainties within various sectors of the economy including trade, agriculture, tourism and other sectors. This suggests that trade is vital in enhancing the production and marketing of various crops due to its role in various steps of value chain for crops from production areas to consumption centres (Lehikoinen, 2021). This implies that a well organised trade will enable households to recover from climate change stress by adopting and applying the appropriate approaches and remain resilient farmers in their area.

Further, trade is viewed as important tool for reducing GHG emission through the spread of clean technologies which are environmental friendly for promoting clean environment. With clean technology the emission per unit of production or consumption can be reduced, which is significant in mitigating climate change and can be achieved through a number of channels within trade (Zimmermann, 2018). Similarly, a study by Dekens (2021) suggests that trade plays a great role of encouraging climate-resilient environmental condition through facilitating the availability and accessibility of goods and services required for adaptation which are either produced or used in a sustainable way to reduce the damaging impacts of climate change.

Despite the positive impact of trade on gaining various ways of adaptation for traders, various challenges hindered their business that make them fail to accumulate a substantial wealth for more prosperity thus ending up with income for satisfying family daily requirements. Through FGDs various challenges were ranked from the major to minor challenges facing them. It was revealed that inadequate capital was their major constraint followed by climate change. Traders fail to run and invest in big business due to the poor capital they have. Climate change have negatively affected trade in various ways including destruction of infrastructures particularly roads and poor markets with inadequate storage facilities as well as inadequate sunlight to dry paddy ready for milling and inadequate training on entrepreneurial activities.

5. Conclusion and recommendation

5.1 Conclusion

This paper examined the perception of rural households on climate change and the role of trade on climate change adaptation in Kyela District. The study find that households are aware of climate change. The paper argues that trade-related adaptation techniques are important in reducing the shocks related to climate change and variability impacts in Kyela district. The results indicate further that through participation in trade household have accessed new innovation and technology, the required goods and services for adaptation, updated climate

information, alternative income sources and food for households, which consequently improves resilience in their livelihoods. Also through literature review it is evident that trade has a positive influence on climate change adaptation which has implication for livelihood improvement among rural households.

Moreover, trade was observed to have impact on climate change mitigation because through adoption and dissemination of clean technology it reduces the GHG emission in the atmosphere while encouraging the carbon sink. Through trade households obtained access to farm inputs particularly the herbicides that encourages minimum tillage which has implication on climate change as it discourages the exposure of carbon into the atmosphere which subsequently reduces the problem of global warming.

5.2 Recommendations

The study recommends that there should be an integration of trade and climate change issues so as to be able to identify various trade related opportunities for climate change adaptation that can be undertaken efficiently by households at the possible minimum cost.

The study recommends that the government should encourage participation in trade through provision of financial support to improve their capital for their business to ensure sustenance and resilient livelihoods. This is because trade was found to be significant in reducing the adverse impact of climate change.

Since trade is normally performed in markets, the paper recommends that there is a need to improve rural markets for enhancement of trade among rural communities. An improved marketing conditions forms the basis of rural potentials for profitability through trading activities which is essential for both improved livelihoods and resilient agricultural production.

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