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ISSN: 2690-0777 DOI: https://dx.doi.org/10.17352/ojeb

Research Article

# Smallholder farmers' perception on climate change, information needs and adaptation strategies for improved pineapple (*Ananas comosus*) production in Awaé Cameroon

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**Received:** 12 January, 2023
**Accepted:** 28 January, 2023
**Published:** 30 January, 2023

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**Keywords:** Climate variability; Smallholder farmers; Adaptation; Evidence; Pineapple production



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## Abstracts

This study examined smallholder pineapple farmers' experiences of climate variability and change in production, as well as ranked adaptation and information source options using data from primary sources. The primary data consisted of a survey on pineapple growing in Awaé. The analysis revealed that pineapple farmers experience climate variability and change evidenced mainly through irregular rainfall patterns (100%), excessive heat (97.14%), drying of streams (85.71%), and rising temperatures (77.14%). These variabilities cause a change in color and taste (40.00 and 45.71% respectively), a reduction in fruit size and yield (68.57 and 100% respectively), and consequently, a reduction in income from pineapple production. Farmers identify deforestation (54.29 ± 0.51%), bush fires (34.29 ± 0.48%) as the major causes of climate change. Although the use of soil conservation practices (e.g. mixed and rotational cropping), bush fallow and crop diversification emerged as the three main adaptation options employed by smallholder pineapple farmers, climate change has the potential to reduce pineapple production in Awaé. Therefore there is a need for future studies to identify adaptation measures that will help improve pineapple production in the area. These farmers are willing to receive information commencement of rain, the prediction of stopping rain, the impact, adaptation strategies, and mitigation strategies to climate change. They can be informed through phone text messages, television, radio, and even demonstration methods for them to effectively follow up on climate change to better improve their pineapple production in Awaé.



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## Introduction

Pineapple (*Ananas comosus*) is the most economically important plant in the family of *Bromedioideae* [1,2]. It is the third most important tropical fruit in the world after banana and citrus. Pineapple contributes 8% of the world's fresh fruit production [3]. FAOSTAT [4] reported that Thailand is the major producer of pineapple, accounting for 13% of global production followed by Brazil and Costa Rica. In Cameroon pineapple is mostly produced in the Center Region (Bafia and Awaé) and in the Littoral Region (Njombé) where it's being exported to nearby countries such as Equatorial Guinea and Gabon as well as consumed and sold locally. The promotion of pineapple production and export has been effective in improving rural livelihoods through improved income to farmers and reducing poverty, hence participating in the economic growth of the country. This placed Cameroon as the 4$^{th}$ largest producer of pineapple in Africa with the production of 351,574 tons after Nigeria, Kenya, and Angola [5,6] and the 1$^{st}$ in Central Africa [7]. Despite this ranking, many constraints are still facing pineapple production in Cameroon such as climate change.

Climate change is a reality that has been confirmed by the present enormous risk to agricultural production due to the impacts on yields [8-10]. The challenges of climate variability and change are complex to people's livelihoods in Africa [9]. Global future climate anticipated an increase in surface temperature. More intense, and frequent extreme rainfall has become unpredictable in nature, with the mean sea level on the rise in most regions in the tropics [11,12]. The nature and magnitude of climate change impacts on agriculture require knowledge of possible adaptation techniques [8]. Rainfed agriculture is sensitive to climate variability and change which mostly have a negative impact on horticultural crop productivity [13]. Especially pineapple which is very sensitive to climatic variations as excessive heat and irregular rainfall result in low productivity [14,15]. However, pineapple is a Crassulacean Acid Metabolism (CAM) plant so it's drought tolerant and therefore well adapted to arid conditions although the growth is sensitive to climate [16,17]. Nonetheless, the plant cannot obtain the desired sizes needed for flower induction and growth [17] under arid conditions. A rise in temperatures up to 4°C will affect the agricultural industry, indicating that an increase in temperatures and water stress are the major pathways through which climate variability and change affect food security resulting in retarded growth in plants or reduced crop yield [18,19]. This situation will eventually affect the environment, and human livelihoods [20]. These climatic uncertainties will particularly affect smallholder farmers, whose livelihoods depend on agriculture. The extent of climate change impacts felt depends on the extent of adaptation response [9]. So smallholder farmers have to struggle with the rising level of uncertain conditions surrounding their production and limited adaptive capacity [21]. This uncertainty in climate variability and change has resulted in many adaptive measures to mitigate the impact of climate change, hence helping rural communities to better face extreme climatic conditions [20].

So many studies have shown that knowledge of smallholder farmers on adaptation strategies can be used as baseline resources in developing adaptations planned and help to inform development policy and decision-making process [22-24]. Adaptation involves an adjustment in the social and economic structures by stakeholders in response to actual or expected climate and its effects [11]. Climate vulnerability is often high in the developing world, therefore adaptation is recognized as an essential intervention that can be used to address the threats posed by climate change and thereby increase household resilience and food security [25,26]. However, farmers' adaptation practices are closely linked to their awareness and perception of climatic variability changes [27-30]. Individual farmers within communities can only implement adaptive strategies to climatic variability if they can perceive changes in the climate [30]. Smallholder farmers need to use an adaptation approach to cope with the effects of climate change [9].

Studies have shown that adaptation to climate change is very important to farmers because without adaptation strategies farmers will become more vulnerable and will severely affect agricultural production [31]. Studies have reported that the most frequently used adaptation practices by farmers are the use of irrigation, farm diversification, crop diversification, improved crop varieties, change of planting dates, and income-generating activities [32,33]. Although smallholder farmers are likely to be seriously affected by the effects of climate change due to their incapability to adequately adapt to the adaptive strategies [33], only a handful of the farmers take advantage of the adaptation option [22]. This might be a result of a lack of information resources related to climate variability and adaptation measures.

Iwuchukwu & Udoye [14] reported that the majority of the farmers are aware of climate change through newspapers and radio. Farmers need to identify climate change information in order to provide them with specific climate change solutions to cushion, mitigate and adapt to climate change for improved yield and ecosystem balancing [14]. Smallholder farmers especially pineapple farmers need information on the prediction of the starting of rain as well as adaptation strategies to climate variability.

Hence, this study was conducted to specifically ascertain pineapple farmers' perceptions, evidence of climate change, and sources of information on climate change and adaptive strategies for the improvement of pineapple production in Awaé, Cameroon.

## Materials and methods

### Description of the study area

The present study was based on survey data from pineapple farmers in the Awaé municipality in Cameroon, located in the Mefou- Afamba Division in the Center Region of Cameroon. It is located at longitude 3° 52′ 59.88″ N and latitude 11° 52′ 59.88″ E. This region falls under the Humid Forest (bimodal rainfall) Zone (Figure 1) with an altitude ranging from 400 to 1,000 m, an average rainfall ranging from 1,500 mm to 2,000 mm and a mean annual temperature of 21°C ± 2.4°C, characterized by



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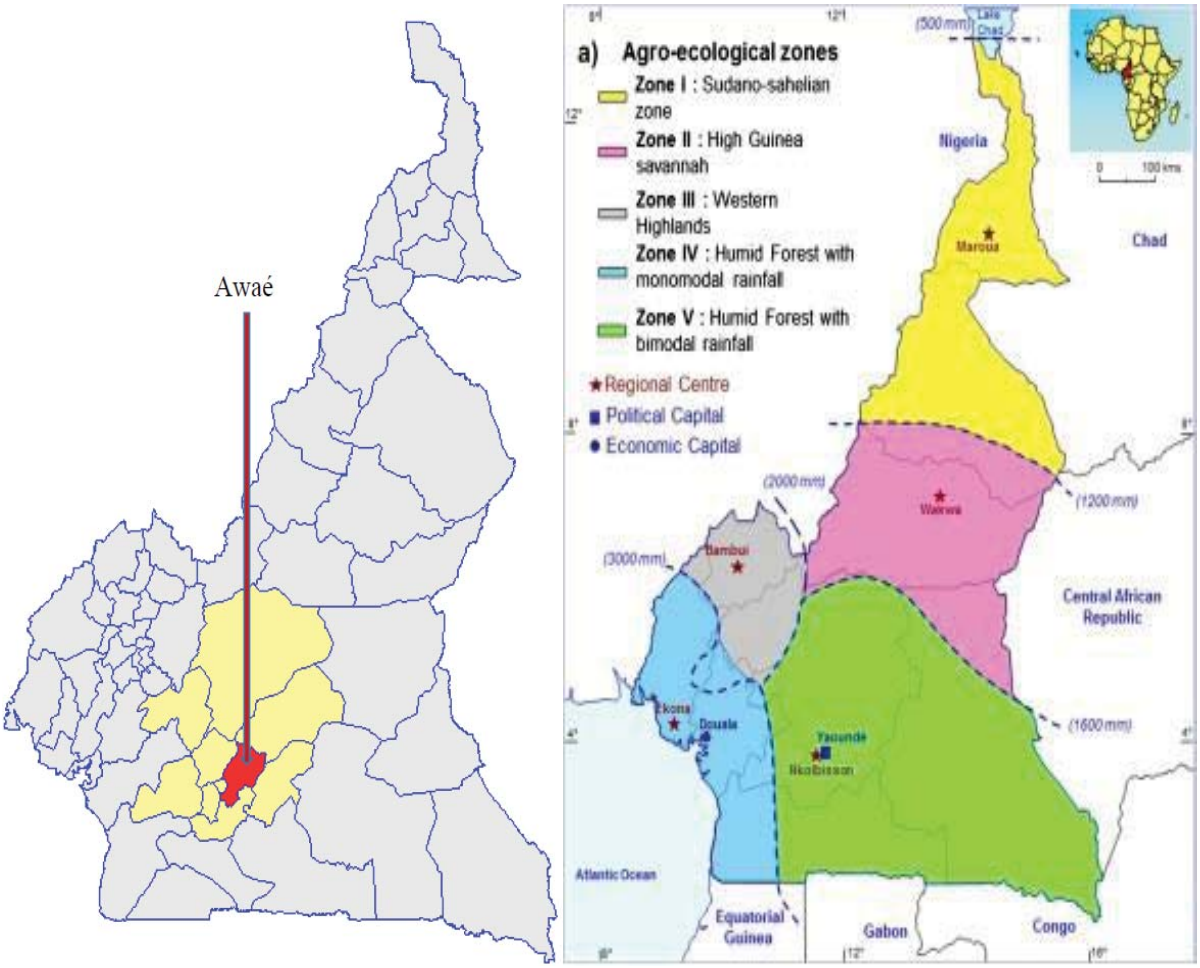


**Figure 1:** Location of Awaé and Agro-ecological zones in Cameroon.

activities such as plantain, cassava, banana, maize, cocoyam, sweet potatoes, cocoa, oil palm, rubber, coffee, maize, cocoa, oil palm, fruits, poultry, pig, fisheries, small ruminants [34]. This zone is characterized by a four-seasonal climate, with rainfall over 1,500 mm and a maximum of two dry months [35].

Mefou- Afamba Division, is on the central axis connecting Douala to the border with the Central African Republic, about 50 km from Yaoundé. It is a big crossroad in the region of the Mvele ethnic group. It is often used as a rest area for travelers going to Akololinga, Ayos, or lomié towards the border, in the eastern region. It is known for its main production of pineapple.

## Survey design

A two-stage sampling technique was used to collect cross-sectional data from smallholder pineapple farmers across Awaé Municipality. The first stage involved a purposive sampling of the study areas and the second stage was the employment of a random sampling technique to select the various respondents for the survey.

A total of 36 smallholder farmers were randomly selected for the interviews. This was done to achieve a sample size of 30 respondents intended for this study as explained by Mason [36] who reported that 30 respondents seem to be an ideal sample size for the most comprehensive research or Ph.D. thesis although studies with fewer respondents such as 10 can still produce applicable results. Semi-structured questionnaires were used to investigate how farmers perceived changes in temperature and rainfall, causes and effects, information sources, and adaptation practices being used by pineapple farmers to climate variability. Data collection was done with the aid of pretested structured questionnaires to correct any inconsistencies. Data collected were mainly on the socio-demographic characteristics of the respondents, climate variability and its related impact on pineapple production as well as adaptation strategies of smallholder pineapple farmers and their information need to climate variability and change in Awaé.

Secondary data was based on a review of relevant sources such as publications, journals, books, and annual reports in order to know strategies used by smallholder farmers in adapting to climate variability in pineapple farming.

## Data analysis

Data were entered and analyzed using Minitab version 17. Frequencies, percentages, and means are the basic descriptive statistical tools used to represent smallholder farmers' perceptions of climate variability/change, information



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needs, and adaptation strategies for improved pineapple. In determining farmers' perceived importance of adaptation practices and information needs using Weighted Average Index (WAI) analysis because it takes into account the relative importance or frequency of some factors in a data and improves on the data accuracy. In this study, the WAI was used to rank the effects of climate change on pineapple performance, and the environment. Similarly, the WAI was applied to the rank farmer-perceived rate of occurrence of weather extremes (i.e. dry spell, drought, and flood), information needs, and adaptation. Respondents were asked to score the weather extremes based on a 0-3 Likert scale (i.e. in terms of 'high', 'moderate', and 'low'). The WAI was then estimated using the formula below as described by Ndamani & Watanabe [37].

$$WAI = \frac{F2W2 + F1W1 + F0W0}{F2 + F1 + F0}$$

$$WAI = \frac{\Sigma FiWi}{\Sigma Fi}$$

*Where F = frequency of response; W = weight of each score; and i = score (3 = highly important; 2 = moderately important; 1 = less important; 0 = not important).*

## Results and Discussions

### Socio-demographic characteristics of pineapple farmers

The socio-demographic characteristics of the respondents are presented in Table 1. All (100.00% ± 0.00%) of the pineapple farmers were male and about 48.57% ± 0.51% of them were within the economic active age of 18 to 60 years. This is encouraging, as it would ensure sustainability and the continued existence of the pineapple industry. This result indicates that pineapple farming in Awaé is gender biased.

The pineapple farmers interviewed had different levels of education (Table 1). Williams, et al. [10] reported that diverse educational levels of farmers give them the ability to willingness and capability to adopt technologies including measures in adapting to changing climate. Generally, education broadens one's point of view about life and helps to understand the social, political, economic, and cultural issues in society [38].

In Awaé 28.57% ± 0.46% of the pineapple farmers had more than 10 years of pineapple farming experience. According to the results, the majority (40.00% ± 0.50%) are novice pineapple farmers, as they had been farming pineapple for 1-3 years with little knowledge regarding pineapple cultivation compared to other farmers who had more than seven years' experience (Table 1). Williams, et al. [10] reported that farmers' knowledge and skills of farming practices are gained through production practices which can influence their ability to adapt and cope with growing conditions including climate variation.

Farmers always come together to facilitate their activities and to share common goals. This coming together is called cooperatives or associations. The results showed that 51.43% ± 0.51% of the pineapple farmers were members of a cooperative while 48.57% ± 0.51% were not involved in any cooperative. Those pineapple farmers who were members of the cooperative had access to loans (23.53% ± 0.43%), and hence had the ability to cultivate more than 7 hectares. The majority (77.14% ± 0.43%) of the pineapple farmers did not have extension contact and had less support from research and development (R&D) institutions (91.43% ± 0.28%). The

**Table 1:** Distribution of respondents according to pineapple farmers' characteristics (*n* = 35).

| Variable | Frequency | Percentage (%) ± SD |
|---|---|---|
| Age (years) ≤ | | |
| 18-35 | 17 | 48.57 ± 0.51 |
| 36-60 | 17 | 48.57 ± 0.51 |
| ≥ 61 | 1 | 2.86 ± 0.17 |
| Gender | | |
| Male | 35 | 100.00 ± 0.00 |
| Female | 0 | 0.00 ± 0.00 |
| Educational level | | |
| Basic | 1 | 2.86 ± 0.17 |
| Secondary | 18 | 51.43 ± 0.51 |
| University | 16 | 45.71 ± 0.51 |
| Years in pineapple farming | | |
| 1-3years | 14 | 40.00 ± 0.50 |
| 4-6years | 4 | 11.43 ± 0.32 |
| 7-10years | 7 | 20.00 ± 0.41 |
| >10 years | 10 | 28.57 ± 0.46 |
| Farm size (ha) | | |
| 1-3Ha | 7 | 20.00 ± 0.41 |
| 4-6Ha | 15 | 42.86 ± 0.50 |
| 7-10Ha | 7 | 20.00 ± 0.41 |
| > 10 Ha | 6 | 17.14 ± 0.38 |
| Farmer Cooperative membership | | |
| Yes | 18 | 51.43 ± 0.51 |
| No | 17 | 48.57 ± 0.51 |
| Access to loan/credit facilities? | | |
| Yes | 8 | 23.53 ± 0.43 |
| No | 26 | 76.47 ± 0.44 |
| Access to market? | | |
| Yes | 35 | 100.00 ± 0.00 |
| No | 0 | 0.00 ± 0.00 |
| Yes, which market? | | |
| Local | 22 | 62.86 ± 0.49 |
| Local & International | 13 | 37.14 ± 0.49 |
| Access to Agricultural Extension Agents(AEA) | | |
| Yes | 8 | 22.86 ± 0.43 |
| No | 27 | 77.14 ± 0.43 |
| Access to R&D | | |
| Yes | 3 | 8.57 ± 0.28 |
| No | 32 | 91.43 ± 0.28 |



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majority (42.86% ± 0.50%) of the farmers had an average farm size (less than 6 ha) indicating they operate on a medium scale level (Table 1). Studies have shown that there is a significant positive relationship between farm size and income generated from pineapple cultivation implying the higher the farm size, the higher the income generated from pineapple cultivation [38,39].

All the pineapple farmers had access to markets. The majority (62.86% ± 0.49%) of the farmers sell their fruits locally while the remaining percentage sell their fruit locally and internationally. This indicates that pineapple farming is a profit-making venture and sustainable for smallholder farmers.

## Awareness and evidence of climate change

All the pineapple farmers in Awaé are aware of climate variability and change (Table 2). Climatic variation poses a great threat to agriculture and its activities [10]. During the survey, pineapple farmers reported that climate variability and change are evident as there is excessive heat, irregular rain, abnormal rise in temperature, and drying up of streams. The farmers mentioned that their growing areas had been experiencing periods of irregular rainfall (100%) as indicated by the drying up of streams (85.71%), especially during the past decade. Farmers also mentioned the rise in temperature (77.14%) that led to excessive heat (97.14%) causing physiological stress to pineapple indicating climate change (Figure 2). It is evident that when farmers are aware of and witnessing climate change, they are likely willing to be informed or accept technology related to climate change [14,30].

The majority (68.57% ± 0.47%) of the respondents agreed that they had access to information sources which is why they are aware of climate variability and changes. In addition to obtaining information on climate change via friends, radio, and television [14,40], internet access via mobile phone (58.33% ± 0.50%) had been their great source of information on climate variability since they can access weather apps on their phones (Table 2). They complained that it is difficult for them to get information from television (16.67% ± 0.38%) since they spend most of their time at the farm and hence get access to television only at night.

## Farmers' perception of the impact of climate change on their pineapple

Climate variability and change may have both positive and negative effects on agriculture, though there are indications of more negative impacts in the long term, and may affect sustainable production and productivity efforts by farmers [10,41].

Pineapple crop is more sensitive to variations in weather patterns brought about by changes and variability in the climate system. According to the pineapple farmers in Awaé, some of the impacts of the variation in climate on production include a reduction in fruit size, reduction in yield, reduction of income from pineapple, change in color, and change in taste. Pineapple farmers confirmed that climate change greatly reduced yield (100%), and pineapple size (68.75%) and changed the taste. The farmer reported that the decrease in yield and size had greatly reduced their sales, hence the reduction of their income (91.43%) (Figure 3). This was similar to the results of other studies that showed similar effects of climatic variation on pineapple production in Nigeria, Uganda, and Ghana [10,14,30,42,43].

## Farmers' Perceived causes of climatic variability on pineapple farming

Most of the pineapple farmers attributed climate change to anthropogenic causes while 8.57% ± 0.28% of the pineapple

**Table 2:** Distribution of the respondents on awareness and sources of information on climate change (*n* =35).

| Variables | Frequency | Percentage (%) ± SD |
|---|---|---|
| Awareness | | |
| Aware | 35 | 100.00 ± 0.00 |
| Not aware | 0 | 0.00 ± 0.00 |
| Access weather information | | |
| Yes | 24 | 68.57 ± 0.47 |
| No | 11 | 31.43 ± 0.47 |
| Yes, where is your information? | | |
| Telephone | 14 | 58.33 ± 0.50 |
| Radio | 6 | 25.00 ± 0.44 |
| Television | 4 | 16.67 ± 0.38 |

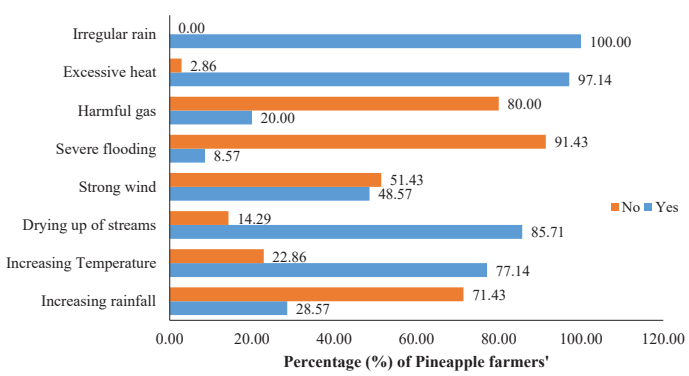


**Figure 2:** Farmers' evidence of climate change (in %).

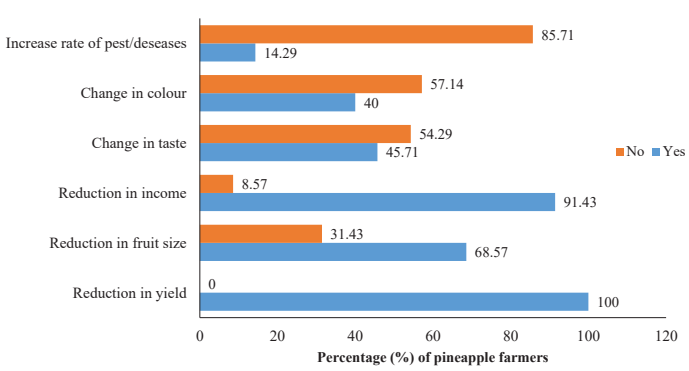


**Figure 3:** Farmers' perception of the impact of climate change (in %) on their pineapple.



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farmers don't think climate change is either caused by human activities or natural causes (Table 3). Anthroprogenic activities such as deforestation (54.29% ± 0.51%) and bushfires (34.29% ± 0.48%) were said to be the main causes of climate change (Table 3). Deforestation activity is largely perceived as for the purposes of fueling wood, charcoal, and farm expansion, while bushfires are believed to be caused by the 'negligence' of hunters, cigarette smokers, and some farmers. This study is similar to the findings of Ndamani & Watanabe [20]; Kusakari, et al. [44] who reported that farmers' perceptions about the causes of climate change are mostly centered on human factors (i.e., deforestation and bushfires).

**Table 3:** Farmers' perceptions about the causes of climate change.

| Cause Variable | Frequency | Percentage (%) ± SD |
|---|---|---|
| Deforestation | 19 | 54.29 ± 0.51 |
| Bush fires | 12 | 34.29 ± 0.48 |
| More than one cause | 1 | 2.86 ± 0.17 |
| Gods/ancestral spirits | 0 | 0 ± 0.00 |
| Do not know | 3 | 8.57 ± 0.28 |

## Adaptation strategies for pineapple production in Awaé

Results from this study show that smallholder pineapple farmers in Awaé have devised several practices and measures for coping with the effects of climate variability and change to adapt to this phenomenon. We used Garrett"s Ranking Technique, to rank the results of measures used by the farmers as adaptation measures during pineapple production (Table 4). Twelve (12) adaptive strategies (factors) were examined, the use of soil conservation practices such as mixed and rotational cropping had the highest weighted average index (WAI) of 2.60, which was considered the main adaptation strategy used by pineapple farmers in adapting to climate variability and change (Table 4). The practice of bush fallow, crop diversification as well as irrigation systems on their farms were the next top three measures ranked after soil conservation practices by farmers in Awaé (Table 4). Soil conservation practices are practiced by farmers in order to prevent soil degradation and build organic matter, increasing soil structure and rooting depth [45]. Results in Table 4 show a positive effect of climate change awareness on soil conservation practices. This indicates the fact that soil conservation is more likely to be practiced among farmers with strong climate change perceptions compared to those with moderate climate change perceptions. This is parallel with the findings of Adger, et al. [46] who suggested that awareness and perception of climate change impacts have a positive and significant impact on the farmers' choice of adaptation options including soil conservation practices. But this contradicts previous studies of Antwi-agree, et al. [30] who reported that soil conservation has a negative and no significant impact on farmers' awareness and perceptions of climate change adaptation. Apart from soil conservation practices, the other factors fall under the broad theme of crop diversification, which is a combination of practices that seek to stabilize production and to a large extent income of farmers. This result also suggests that the pineapple farmers' awareness of climatic change has a positive effect on the probability of farmers adopting crop diversification as an adaptive strategy to climate change. This is contrary to previous studies of Williams, et al. [10]; Antwi-agree, et al. [30] but similar to the studies of Lakhran, et al. [47] who suggested that perception and knowledge of climate change issues encourage farmers to adopt climate change adaptation strategies including crop diversification.

**Table 4:** Farmers' ranking of adaptation practices in Awaé (Number of respondents = 35).

| Adaptive Measures | Highly Important | Moderately important | Less important | Not Important | WAI | Rank |
|---|---|---|---|---|---|---|
| Use of soil conservation practices (e.g. mixed and rotational cropping) | 21 | 14 | 0 | 0 | 2.60 | 1 |
| Practice bush fallow | 19 | 16 | 0 | 0 | 2.54 | 2 |
| **Crop diversification** | 20 | 3 | 12 | 0 | 2.23 | 3 |
| Use of irrigation | 14 | 14 | 4 | 3 | 2.11 | 4 |
| Use of improved pineapple varieties | 12 | 16 | 1 | 6 | 1.97 | 5 |
| Changing the date of planting | 11 | 8 | 16 | 0 | 1.86 | 6 |
| Movement into animal production | 14 | 4 | 12 | 5 | 1.77 | 7 |
| Increase production of crops | 17 | 0 | 9 | 9 | 1.71 | 8 |
| Shift from pineapple production to other non-agricultural enterprises | 15 | 1 | 10 | 9 | 1.63 | 9 |
| Adoption of organic farming | 8 | 2 | 15 | 10 | 1.23 | 10 |
| Reduction of pineapple farm size | 5 | 2 | 21 | 7 | 1.14 | 11 |
| Water conservation practices such as mulching | 0 | 8 | 22 | 5 | 1.09 | 12 |

The measure ranked as the least effective adaptation strategy used was water conservation practices such as mulching (Table 4). Other measures such as reduction of pineapple farm size, adoption of organic farming, and shift from pineapple production to other non-agricultural enterprises are adaptation strategies also found to be used by smallholder pineapple farmers in adapting to the effects of climate change and variability. Increasing pineapple production farm size was among the least ranked adaptation measure. This could be because farmers had difficulty predicting weather patterns, especially rainfall hence affecting planting and other operational activities during production. Williams, et al. [10] reported that rainfall and temperature variations produce a delay in pineapple growth and development, resulting in increasing the cost of production of pineapple, which will significantly affect crop revenue.

## Climate change information needs of pineapple farmers

**Information needed by pineapple farmers:** All the pineapple farmers agreed that they need information on the adaptation strategies for climate change, as most of them also needed information on mitigation strategies (91.43%) on climate change (Figure 4). Most of the farmers want to understand the commencement and prediction of the stopping of rain (65.71



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and 88.57% respectively), in other to understand the impact of climate change on their pineapple (94.29%). The respondents are questing for information on the commencement and stopping of rain as a result of the agricultural system in developing countries where agriculture solely depends on the rainfed system and as such irregular rainfall had been cited as one of the major pieces of evidence of climate change. Iwuchukwu & Udoye [14] reported that pineapple farmers need to fortify themselves with information related to rain in order to cope with climate change occurrence.

### Communication methods

From the information needed in Figure 4, pineapple farmers strongly agreed that they would prefer most of their information on climate change be announced on TV (100%), radio (71.43%), through text message (100%), organized workshop/training (68.57%) and demonstration method (82.86%) (Figure 5). In their opinion they prefer this information be communicated to them through their vernacular. Their preference for these methods may be due to the fact that virtually all of them are visible and practical in nature thus enhancing understanding, retention, and probable application of knowledge gained through them Iwuchukwu & Udoye [14]. In their opinion, they prefer this information to be communicated to them through their vernacular.

## Conclusion

The study revealed that farmers are aware of climate change. Erratic weather patterns through floods, droughts, and increase in temperature affect pineapple production and yield. Access to weather information needs to be timely and prioritized in other to help farmers in their decision-making processes in pineapple production, thus helping reduce the effect of climate change. The three most important adaptation measures employed by the pineapple farmers included the use of soil conservation practices (e.g. mixed and rotational cropping), the Practice of bush fallow, and crop diversification. These adaptation measures can negatively impact and reduce pineapple production in Awaé. Future studies are needed to investigate the susceptibility of the production system to changing climate and to effectively identify exposure and sensitivity of pineapple production to climatic changes for the improvement and sustainability of the pineapple industry in Awaé. This will help identify measures that will improve the production of pineapple as well as promote adaptation systems to fight climate change. Information on the prediction of the commencement of rain and stopping of rain as well as adaptation strategies to climate change should be made available via TV and radio using their vernacular or still through text messages on their phone.

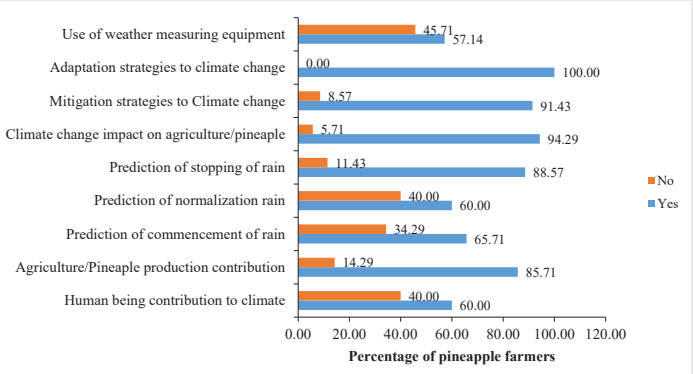


**Figure 4:** Pineapple farmers' information needs on climate change (in %).

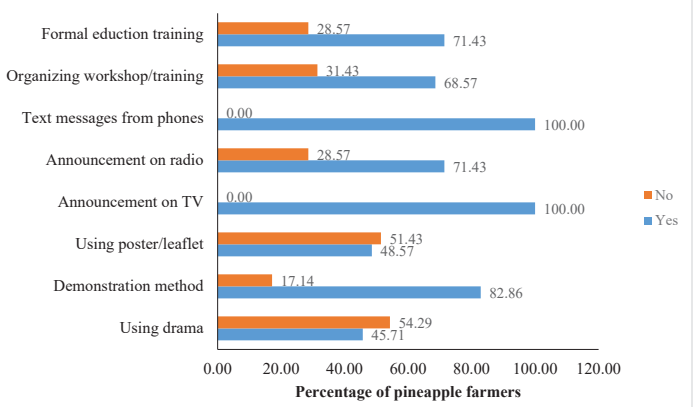


**Figure 5:** Communication methods need on climate change (in %).

## Acknowledgment

The authors thank the Pan African Institute for Development-West Africa Buea, Cameroon for allowing her student to collect the data for this study.

## References

1. Baruwa OI. Profitability and constraints of pineapple production in Osun State, Nigeria. Journal of Horticultural Research. 2013; 21(2): 59-64.
2. Cheng Y, Bartholomew D, Qin Y. Biology of the Pineapple Plant. In Genetics and Genomics of Pineapple, Plant Genetics and Genomics: Crops and Models. 22: 27–40. https://doi.org/10.1007/978-3-030-00614-3_2
3. Yusi MS. The Analysis of Production Function and Farm Marketing efficiency of pineapple (Ananas comosus L. Merr) in South Sumatera Province, Indonesia. African Journal of Agriculture Research. 2016; 11(23): 1990-1998.
4. FAOSTAT. Food and agriculture data. 2017. https://www.fao.org/ (Accessed march 08, 2019).
5. Tilasto (2019) Cameroon: Pineapples, production quantity (tons). https://www.tilasto.com/en/topic/geography-and- agriculture/crop/pineapples/pineapples-production-quantity/cameroon
6. Yaouba A, Metsoa EB, Nseme MYD, Nyaka NAIC. Antifungal effect of plants extracts against Pestalotiopsis microspora responsible for post-harvest rot disease of pineapple (Ananas comosus (L.) Merr) fruit in Cameroon. African Journal of Agricultural Research. 2021; 17(6): 916–922. https://doi.org/10.5897/ajar2020.14962
7. Olembe RY, Fokam BC, Akum OB, Tchotang T, Kenmeugne B. Laboratoire Engineering Civil et Mécanique, Department of Industrial and Mechanical Engineering , National Advanced School of Engineering (ENSPY/UY1), University of Yaounde 1, Cameroun. Journal of Fiber Science and Technology. 2020; 76(12): 378-386. https://doi.org/10.2115/fiberst.2020-0042
8. Moore FC, Lobell DB. Adaptation potential of European agriculture in response to climate change. Nat Clim Change. 4(7): 610-614.
9. Saguye TS. Farmers' Perception of Climate Change and Variability and its Implication for Implementation of Climate-Smart Agricultural Practices: the



**Citation:** Tchoupe MC, Monono EY, Assonwa E, Liengu Monono KH, Mbomi ES (2023) Smallholder farmers' perception on climate change, information needs and adaptation strategies for improved pineapple (*Ananas comosus*) production in Awaé Cameroon. Open J Environ Biol 8(1): 001-009.
DOI: https://dx.doi.org/10.17352/ojeb.000033

Case of Geze Gofa District, Southern Ethiopia. Journal of Geography & Natural Disasters. 2017; 07(01): 18–32. https://doi.org/10.4172/2167-0587.1000191

10. Williams PA, Larbi RT, Yeboah I, Frempong GK. Smallholder farmers' experiences of climate variability and change on pineapple production in Ghana : Examining adaptation strategies for improved production. Journal of Agricultural Extension and Rural Development. 2018; 10(2); 35-43. https://doi.org/10.5897/JAERD2017.0919

11. Intergovernmental Panel on Climate Change (IPCC) (2014) Synthesis report. In: Core Writing Team, Pachauri RK, Meyer LA, editors. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. Geneva: IPCC; 2014; 151.

12. Sheikh FM, Dkhar SE, Singh R, Marboh P. Impact of climate variability on farming : What the farmers of Meghalaya perceive ? In (Ed) Mawlong, B.L., Climate Change and Developing Countries, Cambridge Scholars Publishing, UK. 2018; 153–165.

13. McCarthy J, Canziani O, Leary N, Dokken D, White K. Climate Change 2001: Impacts, Adaptation, and Vulnerability. New York: Cam- bridge University Press; 2001.

14. Iwuchukwu J, Udoye C. Climate Change Information Needs of Pineapple Farmers in Enugu State, Nigeria. Journal of Agricultural Extension. 2014; 18(1): 73–83.

15. Williams PA, Crespo O, Atkinson CJ, Essegbey GO. Impact of climate variability on pineapple production in Ghana. Agriculture & Food Security. 2017; 6(26): 1–14. https://doi.org/10.1186/s40066-017-0104-x

16. Cunha GA. Applied aspects of pineapple flowering. Bragantia. 2005; 64(4):499–516.

17. Tachie-Menson JW, Sarkodie-Addo J, Carlson AG. Effects of weed management on the prevalence of pink pineapple mealybugs in Ghana. J Sci Technol. 2014; 34(2): 17-25.

18. Deuter P. Defining the impacts of climate change on horticulture in Australia. Report prepared for the Garnaut Climate Change Review, Canberra. 2008.

19. Sthapit BR, Rao VR, Sthapit S. Tropical fruit tree species and climate change. Biodivers. Int New Delhi. 2012; 15–26.

20. Ndamani F, Watanabe T. Farmers' Perceptions about Adaptation Practices to Climate Change and Barriers to Adaptation: A Micro-Level Study in Ghana. Water. 2015; 7: 4593–4604. https://doi.org/10.3390/w7094593

21. Carr ER, Thompson MC. Gender and climate change adaptation in agrarian settings: Current thinking, new directions, and research frontiers. Geogr. Compass. 2014; 8(3):182-197.

22. Fosu-Mensah BY, Vlek PLG, MacCarthy DS. Farmers' perceptions and adaptation to climate change: A case study of Sekyeredumase district in Ghana. Environ Dev Sustain. 2012; 14: 495- 505.

23. Nhamo N, Donald M, Fritz OT. Adaptation strategies to climate extremes among smallholder farmers: A case of cropping practices in the Volta Region of Ghana. Br J Appl Sci Technol. 2014; 4(1): 198.

24. Burnham M, Ma Z. Linking smallholder farmer climate change adaptation decisions to development. Clim Dev. 2014; 8(4): 289-311.

25. Sonko E, Florkowski WJ, Agodzo S, Antwi-Agyei P. Subsistence farmer knowledge of strategies alleviating food insecurity in the context of climate change in the lower river region of the Gambia. Food Secur 1–18. 2020; https://doi.org/10.1007/ s12571-020-01024-z.

26. Antwi-Agyei P, Nyantakyi-Frimpong H. Evidence of climate change coping and adaptation practices by smallholder farmers in northern Ghana. Sustainability. 2021; 13 (3): 1308. https://doi.org/10.3390/su13031308.

27. Codjoe SNA, Owusu G, Burkett V. Perception, experience, and indigenous knowledge of climate change and variability: the case of Accra, a sub-Saharan African city. Reg Environ Change. 2014; 14(1): 369–383. https://doi.org/10.1007/ s10113-013-0500-0.

28. Elum ZA, Modise DM, Marr A. Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa. Clim Risk Manag. 2017; 16: 246–257. https://doi.org/10.1016/j.crm.2016.11.001.

29. Mekonnen Z, Kassa H, Woldeamanuel T, Asfaw Z. Analysis of observed and perceived climate change and variability in Arsi Negele District. Ethiopia. Environ Dev Sustain. 2018; 20(3): 1191–1212. https://doi.org/10.1007/s10668-017-9934-8.

30. Antwi-Agyei P, Wiafe EA, Amanor K, Baffour-Ata F, Codjoe SNA. Determinants of choice of climate change adaptation practices by smallholder pineapple farmers in the semi-deciduous forest zone of Ghana. Environmental and Sustainability Indicators. 2021; 12: 100140. https://doi.org/10.1016/j.indic.2021.100140

31. Smit B, Skinner MW. Adaptation options in agriculture to climate change: a typology. Mitigation adapt. Strategies global change. 2002; 7(1); 85- 114.

32. Uddin MN, Bokelmann W, Entsminger JS. Factors affecting farmers' adaptation strategies to environmental degradation and climate change effects: a farm level study in Bangladesh. Climate. 2014; 2: 223-241.

33. Huong NTL, Yao SB, Fahad S. Farmers' perception, awareness and adaptation to climate change: evidence from Northwest Vietnam. International Journal of Climate Change Strategies and Management. 2014; 1–48.

34. Okolle JN, Monono EY, Tabikam AI, Kinge MS, Rodrique MPF. Insecticide Use and Application in Cameroon. In Intechopen [Insecticides]. 2022; 1–31. https://doi.org/10.5772/intechopen.102634

35. Mekou YB, Tiani AM, Somorin OA, Sonwa DJ. Exploring vulnerability and adaptation to climate change of communities in the forest zone of Cameroon Exploring vulnerability and adaptation to climate change. Climatic Change. 2013; 199(3-4): 875-889 https://doi.org/10.1007/s10584-013-0738-z.

36. Mason M. Sample Size and Saturation in Ph.D. Studies Using Qualitative Interviews. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research. 2010; 11(3):8. https://doi.org/10.17169/fqs-11.3.1428

37. Ndamani F, Watanabe T. Determinants of farmers' adaptation to climate change : A micro-level analysis in Ghana. Scientia Agricola. 2016; 73(3): 201–208.

38. Hasan SS, Ali MA, Khalil MI. Impact of Pineapple Cultivation on the Increased Income of Pineapple Growers. The Agriculturists. 2010; 8(2): 50-56.

39. Mondol MAS, Chowdhury MF, Bahadur MM. Effect of Existing Homestead Agroforestry on the Socieconomic Development in Two Selected Upazilas of Dinajpur District of Bangladesh. Bangladesh J Training Dev. 2005; 18(1&2):79-86.

40. Okoro JC. Climate change information needs of rural farmers in Enugu State, Nigeria. Unpublished M.Sc. thesis, Department of Agricultural Extension, University of Nigeria, Nsukka. 2012.

41. Nyadzi E. Climate Variability since 1970 and Farmers Observations in Northern Ghana. Sustain Agric Res. 2016; 5(2): 41.

42. Mugambwa EK. Effects of Climatic Variability on Pineapple Growing in Uganda: A Case Study of Pineapple Growers in Kangulumira Sub-county, Kayunga District. LAP Lambert Academic Publishing, ISBN: 978-8484-8828-5 OmniScriptum GmbH & Co. KG. 2014.

43. Fadairo O, Williams PA, & Nalwanga FS. Perceived livelihood impacts and adaptation of vegetable farmers to climate variability and change in selected sites. Environment Development and Sustainability. 2020; 22(7): 6831–6849. https://doi.org/10.1007/s10668-019-00514-1



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DOI: https://dx.doi.org/10.17352/ojeb.000033

44. Kusakari Y, Asubonteng KO, Jasaw GS, Dayour F, Dzivenu T. Farmer-perceived effects of climate change on livelihoods in Wa West District, Upper West Region of Ghana. Journal of Disaster Research. 2014; 9: 516–528.

45. Prager K, Posthumus H. Socio-economic factors influencing farmers' adoption of soil conservation practices in Europe. Hum. Dimens. Soil Water Conserv. 2010; 12: 1-21.

46. Adger WN, Dessai S, Goulden M, Hulme M, Lorenzoni I. Are there social limits to adaptation to climate change? Climate Change. 2009; 93: 3–4; 335–354.

47. Lakhran H, Kumar S, Bajiya R. Crop diversification: an option for climate change resilience. Trends Biosci. 2017: 10 (2); 516–518.





**Citation:** Tchoupe MC, Monono EY, Assonwa E, Liengu Monono KH, Mbomi ES (2023) Smallholder farmers' perception on climate change, information needs and adaptation strategies for improved pineapple (*Ananas comosus*) production in Awaé Cameroon. Open J Environ Biol 8(1): 001-009.
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