The Impact of Rainfall and Temperature on Food and Nutrition Security in Bongo District, Ghana: The Voices of the People

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ABSTRACT

The Upper East region of Ghana is known to be particularly vulnerable to climate change and its associated impacts such as decreased rainfall, drought and food insecurity. These adverse impacts are skewed towards the poor, women and children. This study examined the awareness and knowledge of farmers, agriculture extension officers and meteorological officers on climate change and its impact on food and nutrition security within the Bongo district of the Upper East region. Four (4) focus group discussions and thirteen (13) key informant interviews were conducted in four (4) farming communities (Anaafobiisi, Bogrigo, Gorigo and Gowrie). Data were collected on awareness of climate change, coping strategies, effect of climate change on food crop production and consumption patterns within households. The data were then transcribed and analysed using Nvivo 10 software based on identified thematic areas. The findings indicated that poor rainfall pattern affected food crop production, resulting in poor household food consumption patterns. Although the level of awareness of the causes of climate change was low among the participants, they had a fair idea about climate variations across the district. High levels of misconception regarding causes of climate change were also reported. Effective education and sustainable strategies are needed to mitigate the effect of climate change on agriculture in order to improve food and nutrition security at the household level.

Keywords: Climate change, household food security, focus group discussion, Upper East Region, Bongo District

Introduction

Globally, droughts, extreme temperature events and floods have witnessed significant changes since the twentieth century. These extreme weather events have affected food crop production and food systems, thereby threatening food security, especially in developing nations (Lesk *et al.*, 2016). In developing countries like Ghana, food crops such as maize, rice, soybeans, sorghum and other smaller grains are very sensitive to extreme temperature during their flowering stages. For instance, maize has 3-5 days of anthesis while the rest have 7 or more. Hence, elevated temperature with longer duration may affect the fertility of the crops at their flowering stage, which could result in low yields (Singh *et al.*, 2015).

Agriculture is the major livelihood across West Africa, and it is also the most vulnerable to climate change because it depends solely on rainfall (Roudier *et al.*, 2011). Reduced rainfall leads to drought which has a detrimental impact on water security, resulting in the failure of crops to thrive (Field *et al.*, 2012). On the other hand, extreme rainfall events have a negative impact on food security through flooding of farmlands (WFP, 2012a). In Senegal, farmers perceived climate change factors such as rainfall and wind as the most destructive causes of poor livestock production and decreased crop yields (Mertz *et al.*, 2009).

Currently Ghana is experiencing the impact of extreme weather conditions (GAWU, 2012), and in the Upper East region of Ghana in particular where 95.2% of the people are farmers, livelihoods have been disrupted, so that achieving food security in the region is a herculean task (Aniah *et al.*, 2016; Fagariba *et al.*, 2018). In 2012,

the World Food Programme documented that Bongo District was the most food insecure in the Upper East region, with 20% of households being food insecure (WFP, 2012b). This study therefore investigated the awareness and knowledge of people living in Bongo District regarding climate change and its possible effect on food and nutrition security among households in the district, with a view to informing educational campaigns, advocacy for change and policies to mitigate the effects of climate change.

Methodology

Research design, population and setting

A cross-sectional design by Neuman (2003) that employed a descriptive qualitative approach for data collection was used. Key informants' interviews and focus group discussions were conducted. Each focus group was made up of participants, who were food crop farmers and had lived within the Bongo district for more than ten years at the time of the research.

The study was conducted at Anaafobiisi, Bogrigo, Gorigo and Gowrie. The district is 15km away from Bolgatanga, the regional capital. Bongo District shares borders with the Bolgatanga Municipality to the south; Kassena-Nankana West and East districts to the west; and Burkina Faso to the north and east. The district has a land area of 459.5 kilometer square and a total population of 84,545, with females forming about 53.3% (Ghana Statistical Service, 2010). The majority of the populace (90%) are into animal rearing and food crop production. The Frafra and the Bossi are the two dominant ethnic groups.

The climate is characterized by one rainy season from May/June to September/October (an average of 70 rain days a year). The annual rainfall is between 600 mm and 1,400 mm. The rainfall is erratic and is followed by an extended dry season from November to May characterized by cold dry and dusty harmattan winds. Temperature ranges from 12°C at night during the dry season to over 40°C during the daytime. The flora is that of Guinea Savannah. Streams and rivers dry up during the dry season and the trees and grasses wither. Figure 1 shows the map of the study area.

Data collection

Key Informant Interviews: Thirteen key informant interviews were conducted, eight (8) with farmers, two from each of the four communities, with the help of community leaders. Other participants were four agricultural extension officers who oversaw the study communities and the meteorological officer in charge of the district. Discussions were held using open-ended questions and audiotaped with respondents' permission using a digital voice recorder. Each interview lasted for one-hour. The interviews focused on information on level of awareness and knowledge of climate change in the area, its effect on food crop production, and hence, on household food security.

Focus Group Discussions: Four focus group discussions were held, one in each community. Community leaders helped in identifying participants who consented to take part in the discussions. The discussions were held separately for men and women due to cultural contextual factors that might otherwise not allow women to speak freely without intimidation. Each group was made up of 10 participants aged 30-60 years and the sessions were led by a moderator and an assistant competent in the indigenous languages and English. Another assistant took notes and recorded non-verbal communication. The discussions were audiotaped using a digital voice recorder and each lasted for an hour and half. Questions from the interview guide focused on the level of awareness and knowledge of climate change in the area; the impact of climate change on food crop production; changes in food consumption patterns; and coping strategies employed to mitigate the negative impact of climate change during food shortage periods.

Data analyses

The audio recordings of both key informant interviews and focus group discussions were transcribed verbatim. The transcripts were then reviewed by another independent person who coded and analysed them using Nvivo™ 10 software. Thematic content analysis as described by Guest, *et al.,* (2012) was adopted for the interpretation of the qualitative data.

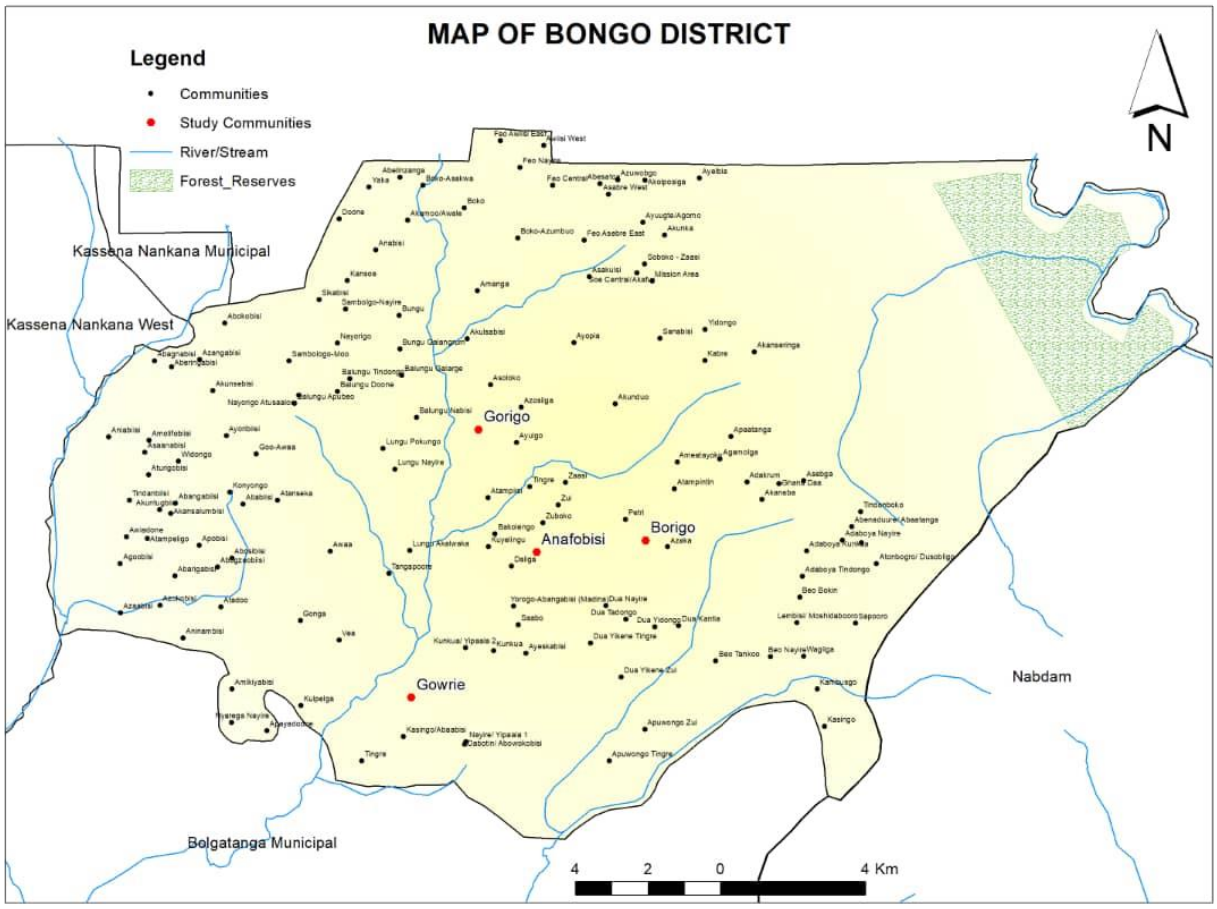

Fig. 1: Map of the study area (study sites were within valley, Zorko and Central zones)
Source: Bantiu Cabral (District Nutrition Officer, Ghana Health Service, Bongo)

Results

Three broad themes identified were: awareness and knowledge of climate change, impact of climate change on food production, and coping strategies employed to mitigate the impact of climate change on households.

Awareness and knowledge of climate change:

Findings from the study revealed that there was a low level of awareness and knowledge of climate change among the farmers. The following were some of the views expressed by the respondents when they were asked what they knew about climate change, using rainfall and temperature as a proxy:

"It is the changes that occur in the moon. Sometimes the moon is dark; other times it is bright" (Male respondent, Anaafobiisi).

"Me I don't know but people have been saying when our crops are dying then the climate has changed" (Female respondent, Bogrigo).

"Hmmm, I know the climate has to do with the weather but I don't know if I can say climate change is the change in the weather" (Male Agric extension officer, Bongo).

"Truly I don't know what climate change is. I only know that the weather is not the same. The sunshine has increased; we have less rain now (Male respondent, farmer, Gowrie).

I think climate change is when the harmattan is very strong and we can't even talk for fear that our lips will crack……." (a 52 year old female respondent, Gurigo).

"It is all about the irregular rainfall pattern in our community" (Female respondent, Gurigo).

However, some of the technical officers were abreast with what climate change is when asked the same question.

"……it is rainfall, temperatures, humidity and so forth. Climate change of an area therefore is the variation or the change in those things that I already mentioned and how it has changed over the period of 30 years" (Male respondent, meteorological officer, Bolga).

The study further explored respondents' knowledge of how the climate has been changing in their respective communities. Findings showed that there was a high level of awareness of various changes that were occurring in the four communities. Respondents identified irregular rainfall, high temperatures, too much heat, the drying up of rivers, and many more. But the change that was reported most was delayed /reduced rainfall. The statements below put into perspective the views of the participants when they were asked how the climate in their community was changing:

"Now we keep shifting the sowing time because you don't know when the rain will come; it delays and stops early too" (Male respondent, Gurigo).

"The time I was a child I never experienced much heat as it is now. Now there is too much heat but little rainfall" (Female respondent, Gowrie).

"……formerly planting starts in April, and by June we use to harvest the early millet and by October the late millet and most of the crops are then harvested too, but because of the change in the rainfall pattern nowadays, we plant late. When you plant late the rains stop early and most of the crops do not mature well resulting in low yield. And consequently lead to food insecurity" (Male Agric extension officer, Bogrigo).

"Of late it looks like we have late starting of rainfalls, compared to former years if I could recall, 10-15 years ago, the rains set in earlier say March or April thereabout, but now it starts around June or even July and is decreasing. Temperatures are also warmer now compared to former times. Around this time, we should be experiencing very cold weather now but it's warmer than it used to be" (Male meteorological officer, Bolga).

However, many of the respondents were not able to mention what the actual cause of climate change is as they attributed it to various things including non-observance of taboos, divine retribution for their many sins and disrespectful youth, among others. These were some of the answers given when respondents were asked what they thought was causing climate change in their community.

"Now our daughters don't get married before they become pregnant. They end up giving birth in the shrines. Since the shrines are responsible for giving us rain and keeping the climate normal, they have changed the climate so that when the sun burns us and we don't get rainfall we will change for the better" (Female respondent, Gurigo).

"We commit too much sin, people kill each for money and others have sex in the bush. A lot of us say we are Christians now so we won't send our sacrifice to the shrine. Why won't the gods punish us by changing the climate?" (Male respondent, Gowrie).

"Climate change is caused by human behavior which has made God angry. Some years ago it was a taboo to have sex in an open space. But now people often do it outside. This has made God to punish us by changing the climate" (Male respondent, Anaafobiisi).

"We were told it is global warming but we don't also know what is causing the global warming" (Male Agric extension officer, Bogrigo).

"It is caused by the way we do farming these days. We cut down many trees, that is why the climate is changing" (female respondent, Gowrie).

"Bush burning, obsolete vehicles, electronic equipment that we use now disturbs the ozone layer causing the climate to change" (Male Agric extension officer, Bongo).

Impact of climate change on food crop production

The findings indicated that most participants were affected by the changing climate that resulted in low yield of food crops, and this they attributed to poor weather patterns. Hence, there is a general reduction in interest in farming. Participants further stated that the returns from farming are not worth investing energy, money and time for several months. The farmers' concerns were corroborated by the technical agriculture officers. These were the views they expressed when they were asked how the changing climate had affected their farming activities and the food crops grown in their community over the past five years:

"Our yields have reduced. The land does not yield anymore. We don't harvest much so we cannot even sell any for money or buy other things including fertilizer. A lot of people go hungry now including my household" (Female respondent, Gurigo).

"I even want to stop farming but if I stop my children and I will go hungry. We harvest so little now due to bad weather and we don't have money to buy fertilizer too" (Male respondent, Bogrigo).

"When I was young we did farming with joy because you would harvest plenty and nobody would go hungry till another farming season. Now I am 62 years when you farm you get just a little so how can I seriously farm?" (Male respondent, Anaafobisii).

"Ten years ago when I planted maize and millet on the small land around this my house, I harvested plenty for food, so that we could sell those we grew on the bigger land outside my house, but now even the big farm is not yielding much, let alone the land around my house. It is not only me; everybody in this community is experiencing poor harvest" (Male respondent, Gurigo).

"It is affecting food production negatively now. People in this community used to have abundant food, especially the cereals, but now, by December most houses have to start buying food from the market or starve most of the time" (Male Agric extension officer, Bongo).

On the effect of rainfall and temperature, it emerged that low or delayed rainfall and high temperature were the climate variables contributing to poor harvest. Below were some perspectives reported.

"The dry season has become longer than before. We used to record rainfall in March but now we do not get rains early" (Female respondent, Gowrie).

"Formally the rains come in March but now the rains start in May, even June, sometimes September or October. When the rains come in June, by October the rains stop. So those crops that need long period to grow, have little rains so they die" (Male Agric extension officer, Bongo).

"Because of very high temperature, when I even fetch water and pour it on my vegetables and maize they still die" (Male respondent, Anaafobiisi).

All the respondents stated that the crops most affected by climate change are the cereals and the legumes. This was what they said when asked: which food crops are the most affected by climate change in this community?

"Almost all the crops, but the cereals and the legumes are the most affected. With the legumes if there is no rain around the fruiting time, the crops do not perform well. Millet too will have small size grains" (Male Agric extension officer, Bongo).

"Groundnuts, beans and millet are the ones most affected" (Female respondent, Gowrie).

On the effect of rainfall and temperature on the food crops grown in the various communities, it was mentioned that erratic rainfall in Bongo District was the cause of crop failure. Participants overwhelmingly acknowledged that poor rainfall patterns and high temperature contribute to crop failure, leading to low yields. Illustrated below are some of their views in response to the question: how have the rainfall patterns and temperature affected your food crop production?

"Rainfall is very irregular in our community. This time, we do not get the rain early as it used to be. Our crops are always failing us because they do not get water" (Female respondent, Gurigo).

"The soil living organisms are dead because of high temperature. Because of this, we don't get better yield" (Male respondent, Gowrie).

"Because of high temperature, I stopped doing vegetable farming. The sun just burns all the vegetables I grow. Life has become very difficult because of this high temperature" (Male respondent, Bogrigo).

The food crops grown in the four communities were millet, sorghum, rice, maize, sweet potatoes, beans, Bambara beans and groundnuts. Vegetables such as okro, kenaf, *aleefu* (*Amaranthus spinosus)* and *ayoyo* (Chorchorus), tomatoes, onions and pepper are also cultivated. Below were some of the responses from the participants when they were asked: which of the food crops were mainly affected by the changes in the weather pattern in this community?

"Rice, millet, and beans are the most affected because they need regular rainfall to do well" (Male respondent, Bogrigo).

"Early millet, sorghum, rice, beans, Bambara beans and groundnuts are the crops that are affected by these changes in the weather" (Female respondent, Gurigo).

The data revealed that the phrase most used with regard to the effect of climate change on household, food consumption was, "not having enough food to eat". The majority of the participants indicated that they do not get enough food to eat in their households due to low yields. Below are some responses to the question: in what ways has the changing climate affected the type of food people eat and the way they ate in previous years?

"Sometimes I don't eat in the morning myself but I give food to my children to eat and go to school. The harvest is mostly poor and we don't get enough. Now when you cultivate rice it doesn't yield well" (Female respondent, Anaafobiisi).

"I don't cook plenty because I don't get good yield from the crops I grow. I don't eat plenty like I used to eat. What I do is that, I do not eat in the afternoon" (Female respondent, Gurigo).

"We don't get enough food to eat. Because the yield is not high we cannot eat three times a day because we don't get enough food" (Male respondent, Anaafobiisi).

"It is not easy for my household to eat well because of the poor harvest these days. We buy from the market to support what is available. We just don't have enough to eat" (Female respondent, Bogrigo).

"Yields are affected and because yields are affected, the little that they harvest does not take them anywhere. A lot of the households' finish what they harvest in October by December" (Male Agric extension officer, Bongo).

Coping strategies employed to mitigate the impact of climate change on households

Our data showed that various coping strategies were employed in the communities to reduce the impact of climate change on families and households. Respondents indicated that some of them reduced the size of their meals and skipped meals, while others migrated to towns and cities for greener pastures. Below were some views expressed in response to the question: What do you do when there is poor harvest or inadequate food for the household?

"Some people do not eat in the mornings and afternoons, they only eat in the evenings" (Female respondent, Gowrie).

"…… we do not eat full bowls of sagituliga (touzafi) again. The women reduce the portions so that everybody can get some to eat." (Male respondent, Gurigo).

"There is also seasonal migration to some part of the northern region. Northern region harvests their crops later than us, so some people migrate to the Northern region to do harvesting and some of them migrate to Brong Ahafo and Kumasi for menial jobs" (Male Agric extension officer, Bongo).

"We travel to places like Kumasi or Accra to work for money; we carry loads for people during the dry season so that we can earn money and use it to buy more food to supplement the little that we harvest" (Female respondent, Anaafobiisi).

"In my house the grown-ups eat once a day when we don't have enough food, but the children eat in the morning and in the evening" (Female respondent, Gurigo).

"We ask for support from family members so that we can purchase foodstuffs when the harvest is poor, or if you have animals you sell them so you can buy food." (Male respondent, Bogrigo).

"For my family we cultivate more beans and Bambara beans which are very good. Normally we eat more of the beans and the Bambara beans during food shortage. When you eat it you drink a lot of water and you do not get hungry soon afterwards" (Male respondent, Bogrigo).

Food preservation has been one strategy used to prepare for the lean season. The common methods used were drying, storing dried crops in traditional barns, putting crops in sacks and treating them with chemicals. The following were some of the responses given by participants when asked how they preserved their food crops to prevent shortage of food in their households:

"I dry what I harvest and put it in barns. If I have money, then I buy the treated sacks and put them inside." (Male respondent, Gowrie).

"We boil the leaves of neem trees in water and sprinkle the water on the beans, millet or maize to preserve it" (Male respondent, Bogrigo).

"I dry my food crops and put the groundnuts in a pot. As for the millet, after drying I heap it on a mat in the storeroom or sometimes in the barn" (Female respondent, Anafobiisi).

"They have these traditional barns which are locally made (built) with clay and sticks. They put the crops there after drying and fetch a little at a time for the women when they need it, especially the millet and the corn. Some of them use these traditional pots for storage of the cereals and the legumes; some just store them in sacks after drying them" (Male Agric extension officer, Bongo).

"Some use botanical preservation. Botanical preservation is the one that they use the leaves of trees, the succulent ones, especially neem tree leaves mix it with the food they want to store. It is done to cereals and legumes" (Male Agric extension officer, Gowrie)

Discussion

Generally, awareness and knowledge of changes in the weather variables were high among key informants and focus group discussion participants. Participants mentioned, among others, delayed and decreased rainfall patterns, hotter days experienced, drought and stronger winds. Although participants could not quantify their observations, their assertions are consistent with the findings of Rasul *et al.* (2011) who reported an increase in temperatures from 0.7°C in the 20th century to 1.0°C in the 21st, making it the warmest century ever; the result is havoc and abnormalities in the climate system globally. Similarly, in Uganda, delayed rainfall and inconsistent timing of rain have made it difficult for farmers to forecast the best period to sow (Okonya *et al.*, 2013), and this situation is taking its toll on food crop production and availability.

Rainfall data collected between 1960 and 2006 revealed a mean decline of 2.3mm (GPJ, 2013). Furthermore, trend analysis of 30 years of data on rainfall and temperature (1986-2015) collected from the Ghana Meteorological Department (2016) indicates a decrease in rainfall of approximately 9.0mm at the rate of 0.3mm/year and an approximation of minimum temperature changes over the same period showed a marginal increase of 1.2°C at the rate of 0.04°C in the Bongo district (Atitsogbey *et al.*, 2018). Etwire *et al.* (2013) reported that Northern Ghana was the most susceptible to the erratic weather pattern caused by extreme weather events than the other regions of the country due to its drier and poorer nature, and these conditions affect the majority of people involved in subsistence agriculture (Etwire *et al.*, 2013). These observations corroborate those made by participants about decreased rainfall and increased temperatures over the years.

Although knowledge and awareness of the climate change events were high among the participants, there were misconceptions about what climate change is and what

causes the changes in climate. These misconceptions are embedded in cultural contextual factors such as divine retribution and the engagement of young females in premarital sex in the fields. These beliefs are in sync with others reported in a study by the Asia Foundation (2014), where 46% of the respondents believe that climate change is the work of God, while 31% believe that it is caused by the action of human beings. In particular, rural households with inadequate access to weather reports are most likely to misconstrue the alterations in weather patterns, especially extreme atmospheric conditions, as the results of non-observance of sacraments and cultural practices (Nyanga *et al.,* 2011). Clearly, within the African context superstition continues to influence perceptions of the causes of climate change and may partly explain the sentiments observed.

With respect to coping strategies to ensure food and nutrition security, participants reduced meal size, skipped meals, migrated to bigger towns and cities to do menial jobs and depended on relatives elsewhere. These assertions are comparable to those made in a study by the United Nations Standing Committee on Nutrition which reported that droughts and weather associated threats consistently push households to adopt to some deleterious coping mechanisms, such as decreasing the quality and quantity of meals, decreasing health and education expenditures in order to acquire food and selling vital personal assets. These adverse coping strategies could lead to a rise in malnutrition, especially among women and children (UNSCN, 2010). Another coping strategy used by families during food scarcity situations is women reducing their own food intake so as to be able to feed their children and men (Quaye, 2008). Thus, during extreme weather variability, calorie consumption and dietary diversity are compromised, leading to stunting, poor health and loss of revenue (WFP, 2012a; Porter *et al.,* 2014).

Atitsogbey *et al.* (2018) documented that 97.2% of the households in the Bongo district were food insecure. The impact of extreme weather conditions on food security and the debilitating coping strategies has been reported also by other studies elsewhere (Ayanwuyi *et al.,* 2010; Manandhar *et al.,* 2011; Ali *et al.,* 2017; Osbahr *et al.,* 2011; Mongi *et al.,* 2010). The situation calls for efforts from all stakeholders to target the causes of climate change and its adverse effects on food crop production in the district if zero hunger (SDG2) is to be achieved in Ghana.

Conclusion

Unstable rainfall and temperature variations are negatively impacting food and nutrition security in the Bongo district of the Upper East Region of Ghana. The farmers are aware of climate change but are helpless to deal with it. There is therefore the need to get all stakeholders to work in unison to mitigate the effects of climate change through education with an approach that considers the entire food system (all the processes involved in food production and consumption) using modern technology.

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