Journal of International Agricultural and Extension Education

Volume 28 | Issue 1 Article 3

2-15-2021

# Issues Challenging Food Security Goals in the Era of Disruptive Change and Opportunities to Revisit Extension Education Strategies

Wayne G. Ganpat
*University of the West IndiesTrinidad, West Indies*

Marcus N. A. Ramdwar
*University of the West IndiesTrinidad, West Indies*



## Recommended Citation

Ganpat, W. G., & Ramdwar, M. A. (2021). Issues Challenging Food Security Goals in the Era of Disruptive Change and Opportunities to Revisit Extension Education Strategies. *Journal of International Agricultural and Extension Education, 28*(1), 24-40. DOI: https://doi.org/10.5191/jiaee.2021.28103

# Issues Challenging Food Security Goals in the Era of Disruptive Change and Opportunities to Revisit Extension Education Strategies


## Abstract

This study examined the challenges to the achievement of food security goals and the role of Extension Advisory Services (EAS) at a time when the world is faced with the double burden of an immediate pandemic in themidst of ongoing climate change events. EAS have always played vital roles in past emergencies around the world and are being challenged to respond timely and appropriately in these times. The purpose of this paper was to (i) describe the impacts of disruptive changes on food systems across the world, (ii) present key agricultural education and extension responses to such changes and (iii) make recommendations to strengthen EAS responses. There was a focus on Covid-19 and climate change as disruptive changes. An internet-mediated approach to source information and a review of published literature were used to gather information. Results detailed the several impacts of Covid-19 and climate change in seven regions of the world, the impacts of both disruptive events on the four pillars of food security, and some global responses in the areas of agricultural education and extension to meet present challenges. Recommendations included the strengthening and deepening of collaboration of all extension service providers at country level to ensure coordinated responses, building stronger community resilience and extension research directed to assist the reengineering of extension organizations in terms of structure, leadership and management



## Keywords

agriculture; extension; climate change;pandemic; food security

*doi: 10.5191/jiaee.2021.28103*

# Issues Challenging Food Security Goals in the Era of Disruptive Change and Opportunities to Revisit Extension Education Strategies

**Wayne G. Ganpat**
University of the West Indies
Trinidad, West Indies

**Marcus N. A. Ramdwar**
University of Trinidad and Tobago
Trinidad, West Indies

## Abstract

*This study examined the challenges to the achievement of food security goals and the role of Extension Advisory Services (EAS) at a time when the world is faced with the double burden of an immediate pandemic in the midst of ongoing climate change events. EAS have always played vital roles in past emergencies around the world and are being challenged to respond timely and appropriately in these times. The purpose of this paper was to (i) describe the impacts of disruptive changes on food systems across the world, (ii) present key agricultural education and extension responses to such changes and (iii) make recommendations to strengthen EAS responses. There was a focus on Covid-19 and climate change as disruptive changes. An internet-mediated approach to source information and a review of published literature were used to gather information. Results detailed the several impacts of Covid-19 and climate change in seven regions of the world, the impacts of both disruptive events on the four pillars of food security, and some global responses in the areas of agricultural education and extension to meet present challenges. Recommendations included the strengthening and deepening of collaboration of all extension service providers at country level to ensure coordinated responses, building stronger community resilience and extension research directed to assist the reengineering of extension organizations in terms of structure, leadership and management.*

*Keywords:* agriculture; extension; climate change; pandemic; food security

## Introduction

In this paper, we examined the challenges to the achievement of food security goals and the role of Extension Advisory Services (EAS) at a time when the world is faced with the double burden of an immediate pandemic in the midst of ongoing climate change events. While food insecurity can be caused by several factors, in recent times issues such as conflicts, weather extremes, economic shocks and health shocks have exacerbated the situation.

Moreover, the present COVID-19 pandemic has brought food security sharply into focus internationally. It has been noted (Foley et al., 2011; Godfray et al., 2010; Kearney, 2010; Matson et al., 1997; Naylor, 2014) that the unprecedented rate of infectious disease emergence and the need to sustainably feed the global population represent two of the most formidable ecological and public health challenges of the twenty-first century.

In January 2020, the World Health Organization (WHO) officially declared the "coronavirus disease 2019" (renamed "COVID-19") as a public health emergency of international concern. Two other examples, just in this millennium, are the Ebola outbreak in West Africa in 2014-16 and the Avian flu virus. While these were not pandemics, they still caused widespread disruption to life and to food production with the consequential negative effects on nationals, particularly the most vulnerable. As noted by Rohr et al. (2019), human infectious diseases can impact the agricultural and economic development necessary to feed the growing human population. Concurrently, with the threat of COVID -19, the price of oil plunged (Albulescu, 2020) with severe implications for countries dependent on food importation. Cullen (2020) suggested that while there are countless ways the food system can be tested and strained with COVID-19 in the future, the supply shock is related to the "logistics of movement of food" and not from availability. The food supply chain is expected to be disrupted with the largest and immediate impact being at the distribution and retail levels. The United Nations World Food Programme reported that a total of 265 million people would be at risk of starvation by the end of 2020 due to COVID-19 and already existing challenges in the food and agriculture sector (Anthem, (2020).

The COVID-19 has come upon a world grappling with the impacts of climate change and together these constitute two of the main pillars of present-day disruptive changes. The impacts of such disruptive changes on food security is a major concern internationally.

The impacts of climate change, as described by Roberts and Rodriguez (2015), are manifested in temperature rise, climate extremes and sea level rise which result in decreased crop and livestock performance and production as well as the loss of soil fertility. Climate change impacts will not be felt equally around the word; with some regions and countries being more impacted than others. Moreover, developing countries with lesser resources are more vulnerable and may be unable to adapt and prepare as readily as more resourced countries. The effects can be seen dramatically in the increased number of deaths. In 2018, climate disasters not only directly affected nearly 30 million people and caused several thousand deaths worldwide (EM- DAT, 2018), but also resulted in severe hunger and malnutrition in the more vulnerable countries across the world.

In recent times, climate changes and pandemics have impacted food in all dimensions, from farm to fork (Committee on World Food Security, 2020). Hurricanes and typhoons cause severe disruption in food availability primarily through loss of crops and livestock and damage to supply

infrastructure. In the Caribbean, hurricane Ivan in 2004 turned Grenada's surplus of $17 million (1.7% of GDP) to a deficit of $54 million and Dominica experienced a $212 million loss to its agriculture, both representing huge impacts on these small island developing states (SIDS). In India, Typhoon (hurricane) Gaja in 2018 damaged 10 million coconut trees, a severe impact on persons' livelihoods in southern states.

Access to food is another immediate concern. It was estimated that in 2017, 1 in every 8 persons suffered hunger and chronic undernourishment (FAO, IFAD, UNICEF, WFP & WHO, 2019). According to latest UN projections, global populations are expected to reach 9 billion in 2037, with China, India and Africa constituting 52% of the world population. If by 2050 world food production is to meet the demand of world population, it has to increase by 60% (FAO, 2017). As such, actions are needed now to enable adequate access to food. The pandemic is expected to shrink the global economy by 5.2% in 2020 with the global model developed by The International Food Policy Research Institute (IFPRI) predicting that for every 1% of economic slowdown, some 14 million people will enter poverty (World Bank, 2020). Impacts would be unevenly felt in most vulnerable communities; for example, the closure of schools disrupted the school feeding program for 368 million children worldwide.

According to Havas and Salman (2011, p.4), "food is our energy source and limited access to food impacts health in multiple ways". Food security and food insecurity are dynamic, reciprocal and time-dependent and the resultant status depends on the interaction between the stresses of food insecurity and the coping strategies to deal with them (Peng & Berry, 2019). However, climate change related challenges are expected to exceed regular coping capacities of small holder farmers through their nature and characteristics, their magnitude and frequency. Roberts and Rodriguez (2015) suggested that to ensure food security, appropriate responses would have to be in several areas including human health.

Food for the world has always been on the international action agenda. However, recent events such as changes to the natural order have brought food issues sharply into focus, particularly highlighting the state of food. Climate change has undoubtedly impacted all agricultural sectors over the last two decades. When the COVID- 19 pandemic is added to the mix, impacts have been exacerbated, and if left unaddressed, experts have suggested will lead to increased poverty, malnutrition and death especially among the more vulnerable population due to both unavailability of and access to food.

Researchers and development workers are addressing these impacts in a myriad of ways. Some lessons have been learnt from the ongoing climate change events. EAS have always played vital roles in times of emergencies and have been responding. However, a deeper investigation of the roles for agricultural education and extension to assist stakeholders cope, moreover prosper in times of disruption is the focus of this paper.

## Objectives

The purpose of this paper was to (i) describe the impacts of disruptive changes on food systems across the world, (ii) present key agricultural education and extension responses to such changes and (iii) make recommendations to strengthen EAS responses.

## Methodology

The study adopted a qualitative internet-mediated research approach to source information related to the potential

global impact of disruptive events on food security. Google search engine, because of its result retrieval effectiveness (Sahu et al., 2016) was used to source documents online. Although Google Scholar focuses on scholarly literature, Google provided a broader scope and retrieved resources regardless of where it originated online.

The three countries from six regions around the world with the highest number of confirmed COVID-19 cases were selected from data presented in the "Coronavirus disease 2019 (COVID-19) Situation Report -75" published by the World Health Organization (2020, p.2). The regions and selected countries, as well as COVID-19 cases, are identified in Table 1. The Google search was done using the format, "country, coronavirus and food security". The Caribbean was also specifically searched using the format "Caribbean, coronavirus and food security". The Caribbean was included to highlight this developing region of the world as a separate region with its unique experiences with the pandemic as small islands developing states (SIDS) with low numbers of reported cases yet substantial negative impacts on GDP.

A total of 57 articles were evaluated for the study – representing three articles from each of the eighteen countries across the six regions and three articles from the Caribbean search. The online searches were undertaken in April 2020. In a similar manner, searches were conducted for "country, agriculture and climate change" in an attempt to establish climate change as a disruptive event parallel to the current pandemic. A total of 47 articles were evaluated.

An inductive content analysis approach was utilized to analyze the information retrieved from the online searches. The actual procedures for the analysis followed the four-stage process outlined by Bengtsson (2016) for content analysis: decontextualization, recontextualization, categorization, and compilation. In the categorization stage, each theme derived was categorized as an impact. Both pandemic and climate change impacts were evaluated in relation to FAO (2008) dimensions of food security, namely availability, access, utilization and stability.

A review of the literature on the actions taken within the last five years to manage disruptive changes due to climate change and COVID-19 was then conducted to examine the responses in the area of agricultural education and extension.

The procedures governing the trustworthiness of the analysis were adapted from Elo et al. (2014) which provided detailed descriptions for the preparation, organization and reporting phases of the study. The findings of the study were presented as narratives in relation to the impacting themes.

**Table 1**

***Countries within Regions of the World with the Highest Cases of COVID-19***

| Regions & Selected Countries | Total Confirmed Cases |
|---|---|
| **Western Pacific Region** | |
| China | 82875 |
| Republic of Korea | 10156 |
| Australia | 5454 |
| **European Region** | |

| | |
|---|---|
| Italy | 119827 |
| Spain | 117710 |
| Germany | 85778 |
| **South-East Asia Region** | |
| India | 2301 |
| Indonesia | 1986 |
| Thailand | 1978 |
| **Eastern Mediterranean Region** | |
| Iran | 53183 |
| Pakistan | 2450 |
| Saudi Arabia | 2039 |
| **Region of the Americas** | |
| United States of America | 241703 |
| Canada | 11731 |
| Brazil | 7910 |
| **Caribbean Region** | |
| Trinidad and Tobago | 97 |
| Jamaica | 47 |
| Barbados | 45 |
| **Africa Region** | |
| South Africa | 1505 |
| Algeria | 986 |
| Burkina Faso | 261 |

**Note:** Adapted from Coronavirus disease 2019 (COVID-19) Situation Report -75 (WHO, 2020). Data as of 4 April 2020..

## Results

### Impacts of the COVID-19 Pandemic Around the World

Table 2 presents a list of impacts of the COVD-19 pandemic and the presence or absence of the impacts in various regions around the world. The pandemic is recent and evolving, thus information for this table is based on what has been published so far in the literature online from web pages, newspapers, magazines, media websites, forums and blogs and portable document formats. The search results did not retrieve any journal articles related to the specific objectives of the study. As such, a comprehensive evidence-based approach was used to select the specific articles from multiple sources to derive the impacts across the world.

Notwithstanding this, the table highlights several threats of the COVID-19 to food security across regions of the world. Access and availability of food seemed to be the major areas of impact across the world. Across almost all regions, episodes of panic buying and stockpiling were the main factors which disrupted the supply and distribution of food. The issue of sustained production arising from labor shortages due to lockdowns and restricted movements of people also affected access and availability of food across all regions except Europe.

In the Western Pacific region, the disruption of food production and storage activities were disrupted, low prices were

received at the farm gate and the effects of stockpiling on the supply chain were the major concerns. In those European countries from where data were available, stockpiling of food impacted the supply chain and this was further aggravated by the decline in agricultural production as a consequence of the lockdown and restricted movement of people, particularly migrant agricultural labor. In the region of South-East Asia, in addition to the impacts on food production and storage activities, stockpiling and unavailability of migrant labor because of the lockdown were also significant factors. In the Eastern Mediterranean region, in addition to those impacts already mentioned for the other regions, there was the further impact on existing humanitarian programs, making access to food by refugees and asylum seekers challenging as a result of the disruption in the supply chain and the lockdown. Notably, this region did not appear, from existing literature, to have experienced any low prices at the farm gate. The pandemic induced challenges to the region of the Americas were associated with; food production and storage challenges, stockpiling actions which disrupted the supply chain, the lockdown and its resultant labor shortages, limited access to food as a result of restricted movements and lockdowns, food waste challenges and trade disruptions.

For both African and Caribbean regions, fewer impacts were reported from the limited literature available online. However, the Caribbean reports suggested that food production activities and storage activities were impacted and humanitarian efforts were stymied and in the African region, the pandemic induced impacts were related to stockpiling, access to food as a result of lockdowns and restricted movements as well as the disruption to humanitarian food aid efforts.

**Impacts of COVID-19 and Climate Change on the Pillars of Food Security**

Table 3 presents the impacts of the pandemic and climate change on the four dimensions of food security. Availability of food was the most impacted pillar for both pandemic and climate change. The pandemic impacted in areas of food production activities and storage, low farm gate prices, labor shortages, disruption to trade and humanitarian efforts. The climate related areas impacted were associated with producers and other stakeholders exiting the food system, challenges to the eco-food system, the impact on agricultural education and knowledge transfer efforts and the impact on farm profits.

The access dimension of food security was reportedly impacted by issues related to stockpiling of food, labor shortages as a result of restrictions of migrant labor, the disruptions to trade and humanitarian efforts. The stability dimension was impacted by lockdown activities, both through access to food and as a result of unavailability of migrant labor, its effect on humanitarian efforts actions associated with education and knowledge transfer and on farm profits. While the utilization dimension was least impacted by both events, it was definitely impacted by agricultural education and knowledge transfer efforts.

The impact of the pandemic on existing humanitarian efforts was manifested across all four food security pillars and agricultural education and extension impacted three pillars.

**Table 2**

***COVID-19 Impacts by Regions Around the World***

| Impacts | Regions | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Western Pacific** | **Europe** | **SE Asia** | **Eastern Med** | **Americas** | **Africa** | **Caribbean** |
| -on food production activities and storage. | X | | X | X | X | | X |
| -low prices at the farm gate. | X | | | | | | |
| -stockpiling on the supply chain. | X | X | X | X | X | X | |
| - lockdown on migrant labor. | | X | X | X | X | | |
| -lockdown on the access to food. | | | X | X | X | X | |
| - on food waste. | | | | | X | | |
| - import disruption on trade. | | | | | X | | |
| - on existing humanitarian efforts. | | | | X | | X | X |

**NOTE:** X denotes presence of impact

**Table 3**

***Pandemic and Climate Change Themes in Relation to the Dimensions of Food Security***

| Impacts | Pillars of food security (FAO, 2008) | | | |
|---|---|---|---|---|
| | **Availability** | **Access** | **Utilization** | **Stability** |
| **Pandemic-related** | | | | |
| - On food production activities and storage | X | | | |
| - Low prices at the farm gate | X | | | |
| - Stockpiling on the supply chain | X | X | | |

| | | | | |
|---|---|---|---|---|
| - Lockdown on migrant labor and agricultural productivity | X | X | | X |
| - Lockdown on the access to food | X | X | | X |
| - On food waste | | | X | |
| - Import disruption on trade | X | X | | |
| - On existing humanitarian efforts | X | X | X | X |
| **Climate-related** | | | | |
| -Exiting the food system | X | | | |
| -Eco-food system challenged | X | | | |
| -Agricultural education and knowledge transfer | X | | X | X |
| -On farm profits | X | | | X |

**NOTE:** X denotes presence of impact

**EAS Actions for Managing Disruptive Changes due to Climate Change**

The integration and implementation of scientific, technological and conceptual policy practices are essential to reduce the negative environmental impacts resulting from critical climatic conditions (Odeleye, 2018). In reference to policy, it was noted that local and global policy-linked research was needed to accelerate sharing of information on agricultural practices and technologies for adaptation and mitigation. Policy initiatives that support the deepening of extension access with information on the appropriate adaptation strategies are crucial to help farmers make climate adaptation choices (Mulwa et al., 2017).

Raj and Garlapati (2020) emphasized the pivotal role of agricultural extension for building resilience to climate change through climate smart agricultural practices. The study highlighted the adaptation of climate-related knowledge, technologies, and practices based on regional requirements, promoting a coordinated learning approach among farmers, researchers, extension workers, and wider dissemination of climate smart agricultural practices, According to Gairhe and Adhikari (2018) Climate Smart Agricultural (CSA) practices involve a wide range of altered farming techniques and promoted innovations such as cultivating resilient varieties, water management, zero tillage, legumes incorporation, cover cropping, site specific fertilizer management, variation in planting date etc. The article provided evidence that CSA could be the most appropriate approach to minimizing the potential losses attributed to climate change.

Climate change resilience training was promoted. This approach has its roots in participatory extension approaches (Odeleye, 2018). The success of participatory extension programmes (PEP) which focused on climate-friendly farming was demonstrated by Knook et al., (2020). The results presented revealed that participants in the PEP showed a higher level of practice adoption compared to non-participants. CSA thus provides a noteworthy opportunity to make the science, which is

still confined within the boundaries of scientific literature, move into operational actions (Sala, Rossi & David, 2016). Curriculum in CSA must be tailored in relation to the challenges which impact agriculture.

The FAO (2019) demonstrated the development of a Farmer Field School curriculum on CSA incorporating solutions to the major problems identified during the needs' assessments and also considering the findings of value chain analysis. FFS approaches to climate change impacts mitigation may be considered as a complementary approach by extension agents in these times to create a cadre of farmers who can develop resilient food systems.

Farmers are being engaged as researchers and active learners in developing their own agrometeorological learning using Science Field Shops (Winarto et al., 2018). In Indonesia, scientists (agrometeorologists and anthropologists) have been working collaboratively on an interdisciplinary basis to introduce climate services to farmers who have become active learners and researchers throughout the establishment of the science field shops on a transdisciplinary basis (Winarto, Stigter, & Wicaksono, 2017). Although the approach proved efficient in improving farmers' knowledge, changing the farmers' habits took some time.

Tumbo et al. (2018), in a study in Tanzania related the behavior of farmers to climate change adaptation through ICTs. It was concluded that the conventional way of using extension agents, on whom farmers largely depend, is no longer sufficient to help farmers obtain information related to climate change adaptation. ICTs have proven to be useful for in-field data collection thereby producing massive data (i.e., big data) relating to different topics in agriculture and climate change. The study further concluded that the integration of ICTs has brought new opportunities for enhancing access to agricultural EAS for climate change adaptation.

Muasa and Matsuda (2018), in a study in rural Kenya found mobile phones to be an essential tool in ICTs. The study established the value of mobile phones to households, which enables them to receive agricultural information on both crop and livestock, information on daily weather, seasonal and projected long-term precipitation and temperature information, onset and cessation of the rainy season and events which help them to plan their farming activities accordingly. The use of mobile phones can be adapted as an essential tool for CSA practices. However, Tegegn and Dafisa (2017) advised that several factors influence the use of mobile phones and these included the high cost of available technologies, inadequate infrastructure and low ICT skills, poor and expensive connectivity, inappropriate ICT policies, language barriers, low bandwidth, inadequate and/or inappropriate credit facilities and systems.

Fath and Koswatta (2018), as a result of a study done in Jamaica, suggested that development organizations and local change agents, inclusive of extension agents, should target the areas of greatest vulnerability. They further opined that extension educators can assist subsistence farmers in understanding better the effects of climate change to reduce their vulnerabilities. Dooley and Roberts (2020) advocated linking climate change education with agricultural and extension education for secondary school agricultural teachers, extension agents/ officers, advisory services, small-scale

farmers, and graduate students who are preparing to enter communities where they can serve as change agents. Bekele and Ganpat (2015), indicated that new content must be taught and innovative methods must be embraced at all levels, advocated designing and launching new curricula, using researched-based information to design curricula and starting climate change education at the pre-and primary school levels in countries that are at greater risk.

The literature review suggests that there is need for more attention in the area of climate change education at all levels and that government policy can enable transformation to climate change resilient practices in food systems.

**Actions for Managing Disruptive Changes due to COVID-19**

The COVID-19 pandemic was generally unexpected. Its impact was severe and swift on the world and in particular the food system, and in the specific areas of availability and access to food. Urgent responses were developed, generally in the absence of full knowledge to help farming communities.

Nash, Brown and Cascio (2020) reported that extension personnel are often required to make guesses based on "what is known so far" determinations, drawing reference to the 2018 Alaska earthquake for which advice was given not knowing whether it was supported by research-based findings. Their advice to extension educators is that best guesses can be improved if there is a network of diverse people and resources to draw upon urgently when extension professionals must make immediate decisions.

Dooley and Roberts (2020) advocated a multidisciplinary approach to build social capital in an effort to develop agricultural and community resiliency to respond to current and future agricultural disasters. Though the article focused on climate change, the current pandemic can be included as a present disaster in the food system, one which they could not have envisaged would be upon the world.

EAS, because of restrictions on gatherings, has shifted to providing information to clientele using remote instructional methods. Tertiary level institutions have done the same. While such are applicable as urgent responses in critical times, caution is urged in the use of such an approach. Lindner et al. (2020) found that secondary agri-science teachers did not collectively define remote instruction and distance education in the same manner. The recommendation was for expanded training of teachers in appropriate delivery strategies for remote instruction. This study would be useful to be done among front-line extension workers and can direct the training needed for them.

Notwithstanding, Narine and Meier (2020) in a study of Utah State University staff, found that extension professionals can adapt to unpredicted events. They further indicated that the capacity to respond was linked to provider's willingness to adapt to changing situations. Immediate actions would be needed to create online education and to work with external partners to coordinate efforts and disseminate information in response to COVID -19. The major recommendation was for extension institutions to conduct their own COVID-19 response assessment to inform delivery efforts and future responses to any other emergency situations.

For students in the Indian agricultural system, Thammi-Raju et al. (2020) listed some recommendations

such as: building the competencies of faculty members to use digital technology for online teaching, ensuring that all students have access to devices, developing digital content such as 3D animations, simulations and videos.

Chen et al. (2020) reported on actions in two severely affected countries. In China, the Ministry of Agriculture and Rural Affairs established an extension and advisory services platform for grass-root agricultural technology extension to mitigate the pandemic impacts). Extension workers provided training and technical support for spring ploughing to ensure production remains on time using online extension platforms for technical guidance and expert consultations. Online market information was made available to help guide crop selection to maximize economic benefits and they helped manage pests and diseases through the publication of timely forecasts and early warnings with appropriate control measures. Extension officers also used their smartphones to connect to the EAS platform for knowledge sharing and management.

In Iran, a country badly affected by the pandemic, the EAS collaborated with the Ministry of Health for public awareness using mass and electronic media; albeit for dissemination of information about the virus and its spread. The EAS were co-opted as part of a working group by the Agricultural Education and Extension Institute in the Ministry of Agriculture to work among agricultural, rural and nomadic communities. They produced apps, electronic pamphlets, videos and text messages for training and information associated with the outbreak.

North Carolina State Extension Forestry staff, in their response, added helping non – extension colleagues to the usual client list and used remote technologies to deliver regional programs and engage with partners (Fawcett et al., 2020).

In Bangladesh, efforts surrounded the strengthening of digital advisory services, facilitating the movement of migrant labor to regions where they are needed most and educating farmers about biosecurity measures, other COVID-19 protocols (Agricultural Extension in South Asia, 2020).

In countries of Africa, Even and Nyathi (2020) reported that IFAD-funded projects responded in a variety of ways; both modern and traditional. In Kenya, a WhatsApp platform was used to provide up to date extension services, including farming guidelines and needs-based support. In Malawi, where access to mobile phones and internet was challenging, radio and television was used, and in Zambia, an online extension platform called M-FLAIS was used to link farmers with latest innovations in fisheries and livestock using a basic mobile phone.

## Discussion, Conclusions & Recommendations

Climate change impacts were felt unevenly around the world and thus the urgency of responses varied. The pandemic affected most countries globally, and being a crisis event, galvanized leaders to urgent actions in a number of areas; one being the need to ensure the availability and access to food for their citizens. The impacts identified under the four pillars of food security showed that climate change impacts were related to overarching issues that needed attention while the pandemic impacts identified related to urgent and immediate issues for attention to meet basic food needs.

Some of the major impacts identified in this paper revolved mostly

around the two of the four pillars of food security; availability and access. These are different, yet interrelated issues. Food availability was most affected and manifested itself in the disruption of food supply chains, the hoarding or stockpiling of food by the larger food producing countries thus making food less available for countries which depend on food imports. One consequence of diminished supply of food at retail outlets was increased prices for foodstuffs, making access to food a serious problem for poorer people.

Further, in the early stages of the pandemic, the restricted movements of farmers meant that they were unavailable to harvest crops. Moreover, markets were closed or use- time was very limited. This resulted in losses for farmers with perishable crops or they were forced to sell at different unofficial market spots at prices below market prices. Some chose to abandon their fields, some exited the sector and unavailability of food was heightened. The lack of sufficient migrant workforce to harvest crops and replant new fields meant that food was going to be unavailable for some time.

EAS can respond in several new or modified roles. The FAO (2020) advocates building partnerships to overcome market disruptions. EAS need to move from the comfort of the production domain and focus much more on the market domain; advising and promoting storage and e-commerce activity. EAS also have to help farmers identify markets for sale of their produce, empower them to use the modern ICTs available to get information on markets; be they temporary selling points and operation times at local/regional markets- not all have to go to centralized markets. There have been several examples of the use of ICTs to do this in Africa, India and China as reported in this study. These constitute good practice for all extension to embrace even as the world emerges from the present crisis. While good efforts have been made, present events show the need for all extension to adopt this approach and the need for hastened action in this area across the globe.

EAS have always tagged home gardening to their efforts. Placing strong emphasis on home food production at the beginning of the crisis was a good initiative by extension organizations worldwide. One wonders why such initiatives were not strengthened in countries most vulnerable and most impacted by climate change. These efforts need to be institutionalized and become a part of the new normal for extension services. Homeowners are now acutely aware of the importance of having access to fresh, nutritious food. A stronger, more dedicated focus on home food production presents an excellent window of opportunities to teach about the state of food as a result of climate change and the need to keep activities ongoing. Ensuring food security is not just a matter for national governments; household food security is a good complement and must be a focus for EAS. Education to ensure good health of producers; farmers, farm families and workers also has to form part of extension education efforts going forward. Without producers, there is no food available.

For any disruptive change, those present and those in the future, extension needs to be ready to respond quickly and effectively. The structure and mandates of organizations need to be revisited. Clearly, they were not set up to face modern challenges. While some countries have indeed modernized their organizations to meet changed demands over time, other have not. Lack of technical capacity and

well as resources to do such may be among the constraining factors. The state of readiness of extension systems and organizations worldwide needs to be assessed and recommendations made for their modernization. Only then can EAS be ready, at the drop of a pin, to respond to any disruption to the food system; be it localized, country- wide or global. Extension education professionals with organization management and leadership expertise are challenged to meet this need.

While there have been previous calls for collaboration of extension service providers, the present situation highlights the slow response to harness the energies and expertise of all extension service providers at country level. This should have been done for climate change, but COVID-19 has shown the need to hasten this action. In many developing countries, a multitude of organizations deliver extension advisory services. Many of them associated with NGOs with specific mandates, often delivering a mix of messages and with some having more resources or access to resources than others and generally all having more resources than state extension services. This may involve sharing of resources; particularly ICT resources. A coordinated response to any negative shocks to the food system would have supported availability and access to food in a better way. Government- led extension needs to provide leadership in this effort by bringing together all extension service providers under a common umbrella and with some common goals.

Efforts in education at all levels need to be revisited. Actions have been taken to revise curricula at some tertiary and pre-tertiary institutions to manage the impacts of climate change; with a focus on promoting climate smart agriculture. This has to be widened to include disruptive events such as hurricanes, typhoons, floods and disease outbreaks. The goal would be to build capacity among the younger generation so that they can respond more effectively to any crisis disruptions that may occur in the future that may negatively impact food, even while the world grapples with climate change. Crisis events however, require different knowledge and skills to manage and agricultural educators have a responsibility to prepare future professionals for such occurrences.

Agricultural and Extension professionals need to engage more research efforts and bring recommendations to advise governments and funding agencies on the reengineering of extension organizations. Professional associations around the world need to take leadership at this time. If this is not done, responses will be knee-jerk; useful but "best guess", to which Nash, Brown and Cascio (2020) pointed as having been used in certain instances. A new set of formalized approaches needs to be developed that is broadly appropriate for various regions around the world. Findings of this research show that the impact of disruptive changes differs by regions. As such, organization type and focus need to be better understood if EAS are to respond timely and appropriately to the next change that disrupts world food systems.

## References

Agricultural Education in South Asia (2020). *Blog 114-Ways to overcome the effects of COVID-19 on Bangladesh agriculture.* AESA. https://www.aesanetwork.org/blog-114- ways-to-overcome-the-

effects-of-covid-19-on-bangladesh-agriculture/

Albulescu, C. (2020). *Coronavirus and oil price crash.* http://dx.doi.org/10.2139/ssrn.3553452.

Anthem, P. (2020). *Risk of hunger pandemic as coronavirus set to almost double acute hunger by end of 2020.* https://www.wfp.org/stories/risk-hunger-pandemic-coronavirus-set-almost- double-acute-hunger-end-2020

Bekele, I., & Ganpat, W. (2014). Education, extension, and training for climate change. In Ganpat & W.P. Isaac (Eds.), *Impacts of climate change on food security in small island developing states* (pp. 361-388). IGI Global.

Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *Nursing Plus Open*, *2*, 8-14. Retrieved from https://doi.org/10.1016/j.npls.2016.01.001

Chen, K., Leclair, M., Karamidehkordi, E., Larsen, C. & Babu, S. (2020). *Extension and advisory services role in the COVID-19 Crisis.* https://www.agrilinks.org/post/extension- and-advisory-services-role-covid-19-crisis

Committee on World Food Security (2020). *Impact of COVID-19 on food security and nutrition (FSN).* Interim High-Level Panel of Experts (HLPE) Issues, 1, 1-8.

Cullen, M.T. (2020). *Coronavirus: Food supply chain under strain. What to do?* Food and Agriculture Organization of United Nations. http://www.fao.org/3/ca8308en/ca8308en.pdf

Dooley, K.E., & Roberts, T.G. (2020) Agricultural education and extension curriculum innovation: The nexus of climate change, food security, and community resilience. *The Journal of Agricultural Education and Extension, 26*(1), 1-3. https://doi.org/10.1080/1389224X.2019.1703507

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis: A focus on trustworthiness. *SAGE Open,* 4, 1-10. https://doi.org/10.1177/2158244014522633

EM-DAT (2018). *The international disasters database*. CRED/ Université catholique de Louvain, Brussels, Belgium. www.emdat.be

Even, M., & Nyathi, P. (2020). *Maintaining critical extension services for smallholders during COVID-19*. IFAD. https://www.ifad.org/en/web/latest/blog/asset/41957955

Fath, K. L. & Koswatta, T.J. (2018). Agricultural livelihoods and climate change: Employing the livelihood vulnerability index in Bluefields, Jamaica. *Journal of International Agricultural and Extension Education, 25*(2), 115-131.

Food and Agriculture Organization (2008). *Food security information for action.* Food and Agriculture Organization. http://www.fao.org/elearning/Course/FC/en/pdf/trainerresources/learnernotes0411.pdf

FAO (2017). *The future of food and agriculture: Trends and challenges*. FAO. http://www.fao.org/3/a-i6583e.pdf

FAO (2019). *Farmer field school curriculum on climate smart agriculture in coastal/delta zone, Ayeyarwady Region, Myanmar. Yangon.* FAO. http://www.fao.org/3/ca3654en/ca3654en.pdf

FAO, IFAD, UNICEF, WFP & WHO (2019). *The state of food security and nutrition in the world 2019. Safeguarding against economic slowdowns and downturns.* FAO. https://www.wfp.org/publications/2019-state-food-security-and-nutrition-world-sofi-safeguarding-against-economic

FAO (2020). *Extension and advisory services: At the frontline of the response to COVID-19 to ensure food security*. FAO. https://doi.org/10.4060/ca8710en.

Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy,E. S., Gerber, J. S., Johnston, M., Mueller, N. D., O'Connell, C., Ray, D. K., West, P. C., Balzer, C., Bennett, E. M., Carpenter, S. R., Hill, J., Monfreda, C., Polasky, S., Rockstrom, J., Sheehan, J., Siebert, S., Tilman, D., & Zaks, D. P. M. (2011). Solutions for a cultivated planet. *Nature,* 478, 337-342.

Fawcett, J. E., Parajuli, R., Bardon, R., Boby, L., Kays, L. & Strnad, R. (2020). Tools for quickly adapting during pandemics, disasters and other unique events. *Journal of Extension*, 58(2). Article #v58-2tt1.https://www.joe.org/joe/2020april/tt1.php

Gairhe, J. J., & Adhikari, M. (2018) Intervention of climate smart agriculture practices in farmers field to increase production and productivity of winter maize in Terai region of Nepal. *J. Inst. Agric. Anim. Sci.,* 35, 59-66.

Godfray, H.C.J., Beddington, J. R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M., & Toulmin, C. (2010). Food security: The challenge of feeding 9 billion people. *Science,* 327, 812-818.

Havas, K., & Salman, M. (2011). Food security: Its components and challenges. *Int. J. Food Safety, Nutrition and Public Health*, *4* (1), 4-11.

Kearney, J. (2010). Food consumption trends and drivers. *Philos. Trans. R. Soc. Biol. Sci*., 365, 2793-2807.

Knook, J., Eory, V., Brander, M., & Moran, D. (2020). The evaluation of a participatory extension programme focused on climate friendly farming. *Journal of Rural Studies*, *76*, 40-48. https://doi.org/10.1016/j.jrurstud.2020.03.010

Lindner, J., Clemons., C. Thoron, A., & Lindner, N. (2020) Remote instruction and distance education: A response to COVID-19. *Advancements in Agricultural development, 1*(2) https://agdevresearch.org/index.php/aad/article/view/39.

Matson, P. A., Parton, W. J., Power, A. G., & Swift, M. J. (1997) Agricultural intensification and ecosystem properties. *Science*, *277*, 504–509. https://doi.org/10.1126/science.277.5325.504

Mulwa, C., Marenya, P., Rahut, D. B., & Kassie, M. (2017). Response to climate risks among smallholder farmers in Malawi: A multivariate probit assessment of the role of information, household demographics, and farm characteristics. *Climate Risk Management*, 16, 208-221.

Muasa, L., & Matsuda, H. (2019) Mobile based agriculture and climate services impact on farming households in rural Kenya. *Journal of Sustainable Development, 12*(2), 1-12.

Narine, L., & Meier, C. (2020). Responding in a time of crisis: Assessing Extension efforts during COVID-19. *Advancements in Agricultural Development, 1*(2), 12-23. https://doi.org/10.37433/aad.v1i2.

Nash, A., Brown, S. & Cascio, J. (2020) Importance of best guesses in emergency situations. *Journal of Extension, 58*(3). Article #v58-3comm2. https://joe.org/joe/2020june/pdf/ JOE_v58_3comm2.pdf

Naylor, R. Ed. (2014). *The evolving sphere of food security.* Oxford University Press.

Odeleye, T.G. (2018). Extension's role and stakeholders' intervention in climate change advocacy. *Int. J. Agric. Environ. Food Sci., 2*(4), 174-176. https://doi.org/10.37433/aad.v1i2.3510.31015/jaefs.18030

Peng., W. & Berry E.M. (2019). The concept of food security. *Encyclopedia of Food Security and Sustainability*, 2, 1-7. https://doi.org/10.1016/B978-0-08-100596-5.22314-7.

Roberts, G., & Rodriguez, M. (2015). An overview of climate change impacts of food security in small island developing states. In W. Ganpat &W. P. Isaac (Eds.), *Impacts of climate change on food security in small island developing states* (pp. 361-388). IGI Global.

Rohr, J. R., Barrett, C. B., Civitello, D. J., Craft, M. E., Delius, B., De Leo, G. A., Hudson, P. J., Jouanard, N., Nguyen, K. H., Ostfeld, R. S., Remais, J. V., Riveau, G., Sokolow, S. H. & Tilman, D. (2019). Emerging human infectious diseases and the links to global food production. *Nature Sustainability, 2*(6), 445-456. https://doi.org/10.1038/s41893-019-0293-3

Raj, S. & Garlapati, S. (2020) Extension and advisory services for climate-smart agriculture. In Venkatramanan V., Shah S. & Prasad R. (Eds.), *Global climate change: Resilient and smart agriculture* (pp. 272-299). Springer. https://doi.org/10.1007/978-981-32-9856-9_13

Sahu, S.K., Mahapatra, D.P., & Balabantaray, R.C. (2016). Comparative study of search engines in context of features and semantics. *Journal of Theoretical and Applied Information Technology, 88*(2), 210-218

Sala, S., Rossi F., & David, S. (2016). *Supporting agricultural extension towards Climate-Smart Agriculture: An overview of existing tools.* Global Alliance for Climate Smart Agriculture. http://www.fao.org/3/a-bl361e.pdf.

Tegegn, M., & Dafisa, A. (2017). Review on potential of mobile phone usage in agricultural information dissemination in Ethiopia. *International Journal of*

*Scientific and Research Publications,* 7, 63-75.

Tumbo, S. D., Mwalukasa, N., Fue, K. G., Mlozi, M. R. S., Haug, R., & Sanga, C. A. (2018). Exploring information seeking behavior of farmers in information related to climate change adaptation through ICT (CHAI). *International Review of Research in Open and Distributed Learning, 19(*3), 301-319.https://doi.org/10.19173/irrodl.v19i3.3229

Thammi-Raju, D., Ramesh, P., Krishnan, P., Soam, S. K., Srinivasarao, C. H., & Agrawal, R. C. (2020). *Re-imagining higher agricultural education in India on the face of challenges from COVID-19 pandemic: Strategies for adapting to the new normal.* ICAR Policy Paper, Indian Council of Agricultural Research (ICAR). https://www.researchgate.net/publication/342282109_Re-imagining_Higher_Agricultural_Education_in_India_on_the_Face_of_Challenges_from_COVID-19_Pandemic_Strategies_for_Adapting_to_the_New_Normal_Think_Tank_Policy_Paper_of_ICAR-NAARM

Winarto, Y. T., Ariefiansyah, R., Prihandiani, A. F., &. Taqiuddin, M. (2018). Nurturance and trust in developing agrometeorological learning in a changing climate. *Indonesia and the Malay World, 46*(136), 360-381. https://doi.org/10.1080/13639811.2018.1502514.

Winarto, Y. T., Stigter, C. J., & Wicaksono, M. T. (2017). Transdisciplinary responses to climate change: Institutionalizing agrometeorological learning through science field shops in Indonesia. *Austrian Journal of South-East Asian Studies*, *10*(1), 65-82.

Word Bank (2020, June 8). *COVID-19 to plunge global economy into worst recession since World War II.* [Press release]. https://www.worldbank.org/en/news/press-release/ 2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war ii#:~:text=WASHINGTON%2C%20June%208%2C%202020%20%E2%80%94,shrink%20by%205.2%25%20this%20year.

World Health Organization (2020). *Coronavirus disease 2019 (COVID-19) situation report -75.* Data as reported by national authorities by 10:00 CET 4 April 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200404-sitrep-75-covid-19.pdf? sfvrsn=99251b2b_4