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**Submission by the World Food Programme**
**To the Subsidiary Body for Scientific and Technological Advice (SBSTA) on recent work in the area of climate impacts on human health.**

*The World Food Programme is pleased to share information on **climate impacts on food security and nutrition,** in reference to the invitation by the Subsidiary Body for Scientific and Technological Advice (SBSTA) to Nairobi Work Programme partners for inputs related to recent work in the area of climate impacts on human health.*

## 1. Introduction: the influence of climate change on food security and nutrition

Climate change poses a particular threat to present and future food security, which is defined by the World Summit in 1996 as "*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life*". Findings from the IPCC's 5th assessment report indicates that climate change could increase the risk of hunger and malnutrition by up to 20 percent by 2050[1]. The negative impacts of the 2015 El Nino event provides a window into what our future climate could look like, where an estimated 60 million people are affected globally, and significantly impacting people's food security and cases of severe acute malnutrition.[2]

The most food insecure and poorest groups in society are already highly vulnerable to seasonal weather cycles, negatively impacting their health and nutrition.[3] Seasonal food scarcity and climate shocks (such as floods and droughts) have long been shown to drive short-term malnutrition and morbidity. When climate hazards or shocks strike, the situation of already vulnerable people can quickly deteriorate into a food and nutrition crisis. Women and children have particular nutritional needs and are disproportionately affected by climate change. As essential agents in ensuring household food security and nutrition, women face inequalities that often limit their access to food, education and health services, alongside early warning and disaster preparedness information[4] increasing their vulnerable to the impacts of different climate hazards.

Malnutrition has been listed by both the IPCC and World Health Organisation as one of the five key health impacts resulting from climate change.[5] While attributing linkages between climate change and nutrition remains a challenge, several studies have assessed the severe impacts of climate change on health and nutrition, and are suggestive of a significant association between child stunting and variables in weather, seasonality and temperature.[6] In Zambia, children born in drought conditions are up to 12 percent more likely to have below-average height and weight than children born in non-crisis years.[7] In Bangladesh, studies show increased wasting and stunting rates among preschool children after floods, due to reduced access to food, increased difficulties in providing

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[1] IPCC, 2014, *Fifth Assessment Report.* https://www.ipcc.ch/report/ar5/

[2] Global Nutrition Report, 2016, *From Promise to Impact*, page 61. http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/130354/filename/130565.pdf

[3] Ibid, page 115.

[4] World Bank, 2016, *Shock Waves: Managing the Impacts of Climate Change on Poverty*. https://openknowledge.worldbank.org/handle/10986/22787

[5] Phalkey, Revati K., Clara Aranda-Jan, Sabrina Marx, Bernhard Höfle, and Rainer Sauerborn, 2015, *Systematic review of current efforts to quantify the impacts of climate change on undernutrition*. Proceedings of the National Academy of Sciences 112, no. 33: E4522-E4529

[6] Ibid

[7] Gitau, R., Makasa, M., Kasonka, L., Sinkala,M., Chintu, C., Tomkins, A. and Fileau, S., 2005, *Maternal micronutrient status and decreased growth of Zambian infants born during and after the maize price increases resulting from the Southern African drought of 2001-2002*. Public Health Nutr 8(7): 837-843.

proper care and greater exposure to contaminants.[8] In the Philippines over the last two decades, 15 times as many infants died in the 24 months after typhoons as died in the typhoons themselves; 80 percent were infant girls.[9] In Niger, Global Acute Malnutrition (GAM) prevalence in the population increases around 4 percent in comparison to a non-drought year, and the recovery times for household food security indicators is at least three years in drought-affected districts of pastoral and agro-pastoral areas.[10] In Ethiopia, children born in an area affected by disaster are 35.5 percent more likely to be malnourished and 41 percent more likely to be stunted.[11]

In general terms, climate change affects nutrition across the four tiers of the food security spectrum. This includes influencing local and global food production that impacts on overall **food availability** to populations; people's **access** to nutritious food through market policies and prices; **food utilisation** by affecting nutritional value and food safety; and the **stability** of these components over time.[12] Some examples of how climate change affects food security and nutrition are:

- **Food availability:** Changes in climatic conditions have already affected the production of some staple crops and this trend is set to continue. The IPCC predicts that without adaptation measures, the production of key crops (wheat, rice, maize) will decline, leading to an increase in overall food prices.[13] Higher temperatures will have an impact on yields while changes in rainfall could affect both crop quality and quantity, ultimately impacting micronutrient availability. Climate change impacts will also lead to increased challenges for vulnerable communities in accessing productive land and fresh water.[14]
- **Food access:** Climate change impacts might translate to an increase in the prices of major crops in some regions. For those most vulnerable, lower agricultural outputs means lower incomes. Under these conditions, the poorest people — who already spend most of their income on food — would need to sacrifice additional income and key assets to meet their nutritional requirements, or resort to poor coping strategies.[15] The expected increase in the number of climate related disasters is also likely to disrupt physical access to food and, combined with increases in food prices, affect food affordability and livelihoods.
- **Food utilisation:** Nutrition is likely to be affected by climate change through related impacts on dietary diversity, care practices and health. Climate-related risks affect calorie intake, particularly in areas where chronic food insecurity is already a significant problem. The impacts of climate change on crop and regional food availability are expected to significantly affect health outcomes due to reduced dietary diversity composition.[16,17] Food quality and safety can be impacted by higher temperatures and extreme weather events, creating a more favourable environment for food-borne pathogens and generating a vicious cycle of disease and hunger.

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[8] Del Ninno, C., Dorosh, P.A. and Smith, L.C, 2003, *Public policy, markets and household coping strategies in Bangladesh: Avoiding a food security crisis following the 1998 floods*. World Development 31(7): 1221–1238.

[9] Anttila-Hughes, Jesse Keith and Hsiang, Solomon M., 2013, *Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster*. Available at SSRN: http://ssrn.com/abstract=2220501

[10] Cabot and Coulter, 2013, *The Economics of Early Response and Resilience: Lessons from Niger*

[11] IPCC, 2007, *Fourth Assessment Report*. https://www.ipcc.ch/report/ar4/

[12] FAO, 2008, *An Introduction to the Basic Concepts of Food Security*, http://www.fao.org/docrep/013/al936e/al936e00.pdf

[13] IPCC, 2014, Working Group II, Chapter 7: *Food Security and Food Production System.* https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/drafts/fd/WGIIAR5-Chap7_FGDall.pdf

[14] World Food Programme, MET Office, *Climate Impact on Food Security and nutrition*. http://documents.wfp.org/stellent/groups/public/documents/communications/wfp258981.pdf

[15] Ibid

[16] Springmann, Marco, Daniel Mason-D'Croz, Sherman Robinson, Tara Garnett, H. Charles J. Godfray, Douglas Gollin, Mike Rayner, Paola Ballon, and Peter Scarborough, 2016, *Global and regional health effects of future food production under climate change: a modelling study*. The Lancet 387, no. 10031: 1937-1946.

[17] Global Nutrition Report, 2015, *Actions and Accountability to advance nutrition and sustainable development*, page 76 http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/129443/filename/129654.pdf

The increased burden on women may also impact their caring and feeding practices, resulting in negative nutritional outcomes for children.

- **Stability:** The climatic variability produced by more frequent and intense weather events can upset the stability of individuals' and government food security strategies, creating fluctuations in food availability, access and utilization. Increased frequency and intensity of climate disasters can make access to productive land and fresh water more challenging, impact crops and disrupt food supplies that may affect both food availability and prices. This can have negative outcomes for people's livelihoods and incomes, and potentially lead to migration or conflict over resources. Climate disasters can also threaten development progress by reducing the capacity of communities and governments to absorb and adapt to climate shocks, producing less favourable enabling environments for addressing the underlying causes of food insecurity and malnutrition, and undermining existing food and nutrition interventions.

## 2. Analyses and innovations to address nutritional challenges imposed by climate change

The work of the World Food Programme (WFP) is focused on supporting the most vulnerable and food insecure around the world. Climate change has a disproportionately negative impact on food insecure people, 80 percent of whom live in countries that are prone to natural disasters and face high levels of environmental degradation, amplifying the impact of floods and droughts. While WFP is working to improve contributions to nutrition across its programmes and activities, it is critical to also link these activities with climate change adaptation measures, recognizing the multiple negative impacts that less predictable rainfall, temperature and weather shocks will have on the enabling environment in which both nutrition-sensitive and nutrition-specific programmes operate. Tackling the additional challenges posed by climate change on food security and nutrition – and at the scale needed – requires a strategic approach that integrates tested instruments in innovative ways.

Working with governments, international partners and local communities, WFP has developed a number of analyses and methodologies, alongside innovations and financial mechanisms to help protect the most vulnerable and food insecure households from climate-related risks to their livelihoods and environments. These analyses have been applied across different livelihood practices and associated agricultural systems, as well as geographical scales (from global to regional, national and local), producing a range of findings that are supporting governments in better understanding the impacts and necessary adaptive measures that should be considered. Below are examples of how WFP and partners work together to enhance knowledge about the potential impacts of climate change to food security and nutrition on the most food insecure populations, and programmatic opportunities to address these challenges.

### a) Food security and nutrition analyses undertaken to understand climate change impacts

Given limited research available on the impacts of climate change on food security (outside a focus on food availability), WFP has invested its food security analysis expertise into undertaking climate analyses that will help the organisation, partners, governments and communities better understand how climate trends may impact on vulnerable people's food security and livelihoods. Supported through the Climate Adaptation Management and Innovation Initiative (C-ADAPT, Box 1), this analysis focus has played an important role in helping governments consider food security and nutrition concerns within national policies and programmes (including National Adaptation Plans and Nationally Determined Contributions) and to help identify appropriate adaptation measures.

A number of different types of climate analyses have emerged from this work, and can be categorised against two types of approaches. **Climate risk analyses** have helped to identify how climate variability will impact people's food security, livelihoods and nutrition. They identify past and

current climate trends as well as geographic patterns of vulnerability, examine how previous climate shocks and stressors align with trends in food security outcomes, and explore the extent to which different sources of food, income and expenditure are sensitive to climate variables, for different wealth groups in different livelihood zones. **Climate change analyses** extend beyond looking at the impact of climate variability on specific variables from the past and present to also applying projections to estimate future impacts (on food security and nutrition?) on those same variables.

Investment in this type of research has seen the emergence of a number of analyses and methodological tools, including:

- **The Consolidated Livelihood Exercise for Analyzing Resilience (CLEAR) methodology:** CLEAR is an analytical approach, developed by WFP, to better understand how food security is affected by climate risks. Such risks can include those related to extreme events (such as droughts, floods and cyclones), or to long-term gradual changes (such as shifting rainfall patterns, rising temperatures, or salinity intrusions from sea level rise). CLEAR builds on the approach developed by FEWSNET for using livelihood zoning and profiling for food security analysis, but with a particular focus on climate risks. A defining feature of this approach is that it takes livelihood zones as the analytical unit rather than administrative boundaries, along with the consultative process used at national and community levels to validate the impacts on people at the local level. WFP has used the CLEAR approach in a number of countries, including Cambodia, Laos, Sri Lanka and Timor-Leste.
- **The Integrated Context Analysis (ICA) tool:** The ICA has been developed by WFP to explore historical trend analyses of existing data on food insecurity, natural shocks and land degradation. Identifying areas of overlap across these dimensions helps to inform discussions from a variety of stakeholders on the most appropriate programmatic strategies in specific geographical areas, with additional, more detailed thematic analyses incorporated as needed. This has led to a number of countries using the ICA method to understand the impacts of climate risks and climate change on vulnerable groups. As an example, the ICA methodology was used in Sudan to combine food security and nutrition data analyses performed by WFP in collaboration with partners, with its trend analysis showing that northern Darfur, Kassala, North Kordofan and Red Sea states are at the highest risk to food insecurity and malnutrition; the most vulnerable groups included traditional rain-fed farmers, pastoralists and nomads. Tajikistan also undertook an ICA, finding the tool particularly useful to WFP in strategically guiding the design and prioritisation of appropriate interventions to address issues that included seasonality, malnutrition, and livelihoods.
- **Food insecurity and climate change vulnerability index:** Current and projected levels of countries' vulnerability to food insecurity have been analysed through the Food Insecurity and Climate Change Vulnerability Index, developed by the UK's Met Office and WFP. Vulnerability is defined by a composite index based on measures of exposure, sensitivity and adaptive capacity. Presented in the form of an interactive map, results show how climate change could impact vulnerability to food insecurity in the least developed countries, both in the present day and future, under different adaptation and emission scenarios. It uses climate model projections and scenarios of socio-economic improvements to compare the benefits of mitigation and adaptation on the scale and geography of food insecurity. Results also highlight to policy makers and the wider public how important it is that large-scale action to both mitigate and adapt will be in our efforts to end hunger by 2030 and beyond.
- **The Shock Impact Simulation Model (SISMod)** is a modelling system to analyse the outcome of shocks (economic, market and production) on food security. The system helps estimate people's needs for food assistance across population, livelihood groups and areas in selected low-income and food-deficit countries. The tool combines data sets from the World Bank, FAO, WFP and National sources on key household/livelihood, economic, market and production data to model

the effect of various key shock factors. Experimentation has being applied to a number of countries to model climate shocks.

- **Climate risk analyses:** WFP has undertaken a number of assessments in countries that include Ethiopia, Mali, Nepal, Kyrgyz Republic, Senegal, and South Sudan where the main focus was on understanding the effects of climate variability. The methodology used has generally consisted of two stages. The first stage focuses on defining the purpose and scope of the study, and identifying data requirements and availability. The second stage consists of a climate vulnerability analysis (including historical climatology, current climate variability, and future climate change projections), baseline vulnerability assessment, a long-term historical analysis (with climate and food security data), and a workshop with partners to validate the results.

Current **lessons learnt** in applying these methodologies highlight in particular the importance of working hand-in-hand with government and partners in both designing and carrying out these analyses, with the additional benefit of helping to build technical capacities of government counterparts for future analysis efforts. Other lessons largely relate to data collection and availability. In many cases there has been a lack of long-term data on key indicators, especially on nutrition, often because this information was not collected in the past. Such research limitations for nutrition have also been identified by WHO and the IPCC[18]. Assessing the contribution of different climate factors to food insecurity can also be challenging; various factors are difficult to quantify but also critical to understanding food security in vulnerable settings. Non-climatic factors are also important to accurately determine the conditions that influence food security..

To address the gaps in nutrition analysis for climate change, WFP is currently exploring how to integrate a climatic lens to its nutrition assessments, including new approaches such as the **Fill the Nutrient Gap tool.** This tool was developed by WFP in 2014 to 2015 with technical inputs from UNICEF and research institutes such as the University of California, Davis, the International Food Policy Research Institute and Epicentre. Analysing where diets fall short of meeting nutrient requirements for vulnerable groups, and understanding the contextual factors contributing to these nutrient gaps, can be key in facilitating the identification and choice of strategies for improving nutrient intake for vulnerable groups, including pregnant and lactating women and young children. WFP has piloted the tool in a number of countries, with a particular focus on increased access to nutrients during the critical first 1,000 days of a child's life. WFP is examining whether the tool can help understand the barriers that climate change can pose for vulnerable people's access to adequate nutrition, especially those most vulnerable to malnutrition.

### b) Innovations supporting positive food security and nutrition outcomes under a changing climate

Different studies have shown that anticipatory responses, including those based on climate forecasts, can result in a range of positive additional benefits for food insecure households and that contribute to reduce their vulnerability and avoided losses in terms of food security, nutrition, and lives. An evaluation of Ethiopia's Productive Safety Net Programme (PSNP) provides evidence of positive impacts on food consumption, reducing annual food gaps of recipients by 0.4 months by 2008 and by 1.3 months in 2010[19]. Food consumption already accounts for more than 60 percent of total spending among poor households. In Africa, the impact of climate change could increase food prices

[18] Phalkey, Revati K., Clara Aranda-Jan, Sabrina Marx, Bernhard Höfle, and Rainer Sauerborn, 2015, *Systematic review of current efforts to quantify the impacts of climate change on undernutrition*, Proceedings of the National Academy of Sciences 112, no. 33: E4522-E4529.

[19] White, P and Ellis, F., 2012, *Ethiopia's Productive Safety Net Programme, 2010-2014*: *a value-for-money assessment.* University of East Anglia, UK.

by as much as 12 percent by 2030 and 70 percent by 2080.[20] In the Middle East and North Africa, income insecurity and limited access to safety nets and basic services make poor consumers in rapidly growing urban areas particularly vulnerable.[21]

In recent years, improvements in forecast-based decision tools have made it increasingly possible to be integrated into anticipatory responses to climate disasters. Forecast information is now more dependable, with technology more readily able to support advances in early warning systems, disaster risk reduction, social protection, adaptation and financial mechanisms. This makes it more feasible for the institutionalisation of climate forecasts within emergency response funding mechanisms, ultimately supporting community-level action to build people's resilience against climate risks. Governments, communities and humanitarian organisations can proactively support those exposed to climate risks before they occur, protecting vulnerable households from adopting negative coping strategies such as selling productive assets that impact incomes, nutrition, food security and health outcomes. Integration of these mechanisms into social protection and safety net programmes allows for a more sustainable approach at scale.

WFP has developed a number of innovations that combine climate information, safety nets and financial mechanisms to be able to anticipate climate disasters and that help reduce negative nutritional outcomes for populations. These programmes also focus on building the resilience and capacities of communities to adapt to the impacts of climate change. Built off WFP's experience in delivering food assistance programmes, these innovations include:

- **Social protection and safety nets.** WFP is recognised for its support to national governments in designing, implementing and evaluating cost-effective food security and nutrition-sensitive safety net and social protection mechanisms for the most vulnerable populations in fragile and challenging contexts. Mechanisms such as asset creation, public works, employment guarantees and nutrition programmes are essential elements in protecting the most vulnerable people from increasing climate extremes, and providing platforms for support to large-scale adaptation. WFP continues to work with national governments and other partners to support the establishment of adaptive and shock-responsive safety nets through the development and scaling up of approaches such as the R4 Rural Resilience Initiative (Box 2).
- **Risk management, finance and insurance.** WFP also plays a leadership role in introducing and scaling up innovative risk financing tools that help food-insecure countries and communities manage increasing climate risk. Tools such as weather index insurance, forecast-based finance and contingency financing can reduce uncertainty and improve livelihoods. When deployed as part of an overall risk management strategy, these instruments allow the poorest and most vulnerable farmers to make and protect investments that increase, improve and diversify their productivity, livelihoods and well-being. Integrating these risk transfer approaches into national plans, programmes and tools, in collaboration with a wide set of partners (including UN bodies, NGOs, national institutions and the private sector) helps governments to build stronger, innovative, more cost-effective, predictable and sustainable response systems and safety nets. Innovations in risk transfer and financing mechanisms include R4 (Box 2), the Food Security Climate Resilience Facility (FoodSECuRE, Box 3), and the African Union's African Risk Capacity (ARC). FoodSECuRE for example, operates as an innovative institutional climate finance tool to trigger action at the community level before, during and after a climate disaster occurs, allowing WFP to scale-up nutrition programming and disaster risk reduction activities so that people

[20] World Bank, 2016, *Shock Waves: Managing the Impacts of Climate Change on Poverty*. https://openknowledge.worldbank.org/handle/10986/22787

[21] Jobbins, G., & Henley, G., 2015, *Food in an uncertain future: the impacts of climate change on food security and nutrition in the Middle East and North Africa*. Overseas Development Institute, London / World Food Programme

enter forecasted crises more resilient and prepared. An integrated risk management strategy such as R4 helps participants mitigate climate-related risks that affect food consumption and nutrition by encouraging savings and insurance uptake.

- **Emergency preparedness and response.** Given the increased frequency and intensity of climate extremes, large-scale global investments in improving the effectiveness and efficiency of emergency preparedness and response systems is needed. WFP is recognised as a global leader in addressing the food security and nutrition needs of populations affected by climate disasters, working with regional, national and local governments, civil society partners and communities to understand how climate change might alter the needs of local communities and to apply this understanding to enhancing emergency preparedness and response capacities. WFP is also working on building national capacities to prepare for and respond to climate and other disasters, and to enhance climate-risk assessments of emergency systems to respond so as to reduce vulnerabilities in food procurement, transport, storage and distribution. Concrete innovations include the German funded Forecast-Based Emergency Preparedness for Climate Risks (FBF), which aims to develop a forecast-based funding mechanism and standard operating procedures that strengthen national preparedness and response capacities in case of a shock forecast.
- **Climate services.** Climate services provide climate information to support the decision-making needs of people managing the impacts of the climate and climate change, enabling them to make better-informed decisions and improve their risk management capacities. WFP has been a lead innovator in this area (including its work with Ethiopia's Livelihoods, Early Warning and Protection, LEAP) and is an active member of the Global Framework for Climate Services (GFCS), where it works with the World Meteorological Organization and other partners to provide innovative and accessible climate services to WFP beneficiaries and partners. WFP also is developing and using climate services to improve internal management decisions and effectiveness, for example by linking El Niño forecasts to advanced preparedness, programming and procurement actions and through the development of forecast-based financing tools.

**Box 1: Climate Adaptation Management and Innovation Initiative (C-ADAPT)**

C-ADAPT is a global initiative that integrates climate and food security analysis into programme and policy design. C-ADAPT emerged in response to gaps in research on the impacts of climate change on food security, and the lack of examples of relevant climate change adaptation programming available to governments, communities and international organizations. Funded by the Swedish Government between 2013 and 2016, C-ADAPT has made WFP a leading innovator in climate analyses that identify food security in different contexts for use by governments in their NAPs and other planning processes. It has also allowed WFP and partners to document case studies and best practices in climate adaptation

**Box 2: The Rural Resilience Initiative (R4)**

R4 was created by WFP and Oxfam America in partnership with technical support from IRI and Swiss Re to develop, test and scale up a comprehensive approach to risk management and climate change adaptation to help communities become more resilient. R4 has been piloted in Ethiopia, Malawi, Senegal and Zambia where it is progressively scaling up and started expanding in new countries. It now reaches more than 40,000 households and is recognized as a leading example of the integration of safety nets, climate risk insurance and resilience-building.

R4 has broken new ground by enabling the poorest farmers to obtain access to crop insurance by paying with their labour through insurance-for-assets (IFA) schemes that are integrated into safety net programmes.

Impact evaluations in Ethiopia show that insured farmers save more than twice as much as those without insurance and invest more in seeds, fertilizer and productive assets. Women, who often head the poorest households, achieved the largest gains in productivity by investing in labour and improved tools for planting.

An impact evaluation in Senegal found that after two years of bad harvests, R4 farmers were better able to cope with climate-related shocks, as they maintained their food security and increased their assets and social capital compared to non-participants exposed to the same risks. The R4 Initiative enabled its participants to improve their food consumption and nutritional needs. Indeed, R4 participants' food consumption increased four times more than non-participants between 2015 and 2016. Furthermore, through the risk reduction component, land was rehabilitated for rice production, which for R4 farmers resulted in production gains of 160 kg (91.4 percent) from 2015 to 2016, compared to 35 kg (42.2 percent) by non-R4 farmers.

**Box 3. The Food Security Climate Resilience Facility (FoodSECuRE)**

WFP developed FoodSECuRE, an innovative institutional climate finance tool to trigger action at the community level before, during and after a climate disaster occurs, allowing WFP to scale-up nutrition programming and disaster risk reduction activities so that people enter forecasted crises more resilient and prepared. The mechanism contains three financing windows, by:

i) Triggering anticipatory action based on climate forecasts, to reinforce community resilience before shocks occur.

ii) Supporting early action by complementing existing, government-led emergency response mechanisms e.g. through replica policies of the African Risk Capacity.
iii) Providing predictable multi-year financing to deliver high-quality community resilience-building and institutional capacity building as part of post-disaster recovery operations.

FoodSECuRE aims to significantly reduce humanitarian response costs for governments and donors. Growing evidence shows that investment in early response and resilience is more cost effective. A study of WFP's response to the 2004 to 2005 food crisis in Niger found that the cost of assistance tripled over a 6 month period, going from US$7 per beneficiary during initial food deliveries in February (four months after the initial humanitarian appeal), to US$23 once the situation had reached crisis status and funding had arrived, in August (ten months after the appeal).[22] An independent study commissioned by the UK's Department for International Development in 2012 to 2013 found that early response was cost-effective in all five countries it examined.[23] For example, early response could reduce humanitarian spending and livelihood losses by $1.5 billion over a 20-year period.[24] The study also found that economic concerns over early response "false alarms" are unwarranted: depending on the country, early action could unnecessarily be triggered two to six times, before the combined costs of those false alarms outweigh those of a single conventional late response. The cost-effectiveness of anticipatory action, starting months before a slow-onset event, are currently being evaluated from small FoodSECuRE pilots.

[22] Chantarat et al., 2007, *Using Weather Index Insurance to Improve Drought Response for Famine Prevention*.
[23] Cabot Venton, 2012, 2013, *The Economics of Early Response and Resilience.* https://www.gov.uk/government/policies/helping-developing-countries-deal-with-humanitarian-emergencies/supporting-pages/helping-countries-protect-themselves-against-future-disasters
[24] Cabot Venton and Coulter, 2013, *The Economics of Early Response and Resilience: Lessons from Niger*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226160/TEERR_Niger_Report.pdf