Climate change's effects on food Security in Sub-Saharan Africa (SSA)

Rahal, Imen and Elloumi, Abdelkarim

Faculty of economics and management Sfax, Tunisia

September 2023

Climate change's effects on food Security in Sub-Saharan Africa (SSA)

Imen RAHAL

University of Sfax, Faculty of Economics and Management Sfax, Tunisia

Imenerahal96@gmail.com

Abdelkarim ELLOUMI

University of Sfax, Faculty of Economics and Management Sfax, Tunisia

Abdelkarim.elloumi@laposte.net

Abstract

Climate change has a dual impact on food security, with direct consequences related to temperature levels and water availability in agriculture, and indirect effects stemming from its influence on disease vectors and pests. This research delves into the economic ramifications of climate change on food security within Sub-Saharan Africa (SSA). The study employs panel data encompassing all SSA nations to scrutinize the repercussions of temperature and precipitation on food security. Specifically, the analysis leverages the coefficient of variation to assess their influence on food security. The findings of this investigation reveal that variations in both temperature and precipitation have an adverse impact on food security. These climate-related variables affect food security by directly impinging on food production and indirectly affecting other indicators of food security. In light of these results, the study advocates for the implementation of ecosystem management and enhancements in production systems. Moreover, it underscores the significant detrimental effects of climate change on food security in the SSA region. To counter these impacts, the study proposes the development of effective land use policies, the conservation of natural resources, the adoption of optimal agronomic practices, and the maintenance of the population at an appropriate level within the region.

***Keywords**: climate change, food security, Sub-Saharan Africa.*

I. Introduction

Sub-Saharan Africa (SSA) encompasses a vast total surface area of 2,456 million hectares (ha). However, when we take into account areas that are deemed useful for various purposes, this total is reduced to 1,532 million hectares. This reduction accounts for the deduction of continental water cover, which amounts to 65 million hectares, settlement areas covering 3 million hectares, and non-cultivable land spanning 856 million hectares.

Nonetheless, climate change has the potential to worsen land degradation through heightened instances of soil erosion and increased frequency of droughts. These environmental changes, in turn, have a multifaceted impact on food security. The effects of climate change, marked by intensified and more frequent disasters, pose threats to food security, human well-being, and access to fresh water. Additionally, they hinder industrial production and inflict damage on physical infrastructure, resulting in diminished overall development prospects. Furthermore, alterations in rainfall patterns and river responsiveness to climate fluctuations lead to decreased river basin runoff and reduced water resources available for both agriculture and hydropower generation.

The influence of climate change on the worldwide ecosystem and its repercussions for agriculture and food security pose a formidable obstacle to the eradication of hunger and malnutrition. Currently, there are approximately 800 million individuals enduring chronic undernourishment, while the number of stunted children under five years old stands at an estimated 161 million. In parallel, around 500 million people grapple with obesity, while a staggering 2 billion lack the vital micronutrients essential for maintaining healthy lives, as reported by (Kurmi et al. 2016).

In 2018, the region saw an alarming 239.1 million individuals grappling with undernourishment, according to (World Health Organization's 2019) report. Consequently, addressing the pressing issue of undernourishment and meeting the escalating demand for food necessitates a substantial increase in agricultural productivity, as highlighted by (Raihan et al. 2022). However, agricultural productivity faces a grave threat from climate change, as emphasized by (Shahzad et al. 2021). This environmental challenge profoundly affects agricultural yields, food prices, food quality, and the poverty landscape within the region, as documented by (Thompson 2023).

Hence, it becomes crucial to evaluate the consequences of climate change on food security within the region. Consequently, this research endeavor serves as a valuable step towards addressing the existing voids in empirical data and putting forth recommendations, including policy considerations. It also plays a pivotal role in enhancing comprehension regarding the necessity of adapting to and mitigating climate change, thereby facilitating the coordination of resources for a more effective response to this pressing challenge.

The primary aim of this investigation is to delve into the effects of temperature and precipitation on food security. Furthermore, it seeks to gauge the extent of food security's susceptibility to climate change. This research endeavors to provide responses to various inquiries that have arisen concerning the influence and vulnerability of climate change on the state of food security. Moreover, it aspires to shed light on the intricate connection between climate change and food security.

II. Literature Review

Food security is a complex phenomenon shaped by a multitude of factors, as highlighted by (FAO in 2013). The World Food Summit provides a comprehensive definition of food security, stating that it prevails when every individual consistently possesses both the physical and economic means to acquire an ample supply of safe and nourishing food that aligns with their dietary requirements and preferences, ensuring an active and healthy life (FAO, 2006). This definition encompasses four key dimensions of food security : the availability of food, its accessibility, its utilization (referring to how it is utilized and assimilated by the human body), and its stability.

Availability pertains to the volume, quality, and variety of food accessible in different types. This entails an adequate quantity of food with appropriate nutritional value, either sourced from domestic production or obtained through imports (such as food aid), as elucidated by (Bozsik et al. 2022). The factors contributing to availability encompass domestic production, storage, distribution, as well as import and export, in accordance with research by (Singh et al. 2023). It is crucial to note that climate change can exert both direct and indirect influences on the availability of agricultural products, as highlighted by (Agostoni et al. 2023). Directly, it affects crop yields, soil fertility, water retention capacity, and the prevalence of crop pests and diseases. Indirectly, climate change impacts economic growth, the demand for agricultural products, and income distribution, as suggested by studies conducted by (Edame et al. 2011). The ecological changes resulting from climate change have a cascading effect on factors such as land suitability, the achievable yield potential, and the types of crops currently cultivated, as indicated by (Alagidede et al. 2016).

Access refers to the capacity of communities, individuals, and nations to procure food in adequate quantities and of satisfactory quality. Climate change affects physical access to food through declines in production and disruptions in transportation infrastructure. Economic access, on the other hand, is reflected in domestic food prices, reductions in purchasing power, and the prevalence of undernourishment, as outlined in the report by (Lara-Arévalo et al. 2023). It's important to note that access to food is influenced not solely by physical and economic factors but also by social and political variables. The mere physical availability of food does not guarantee access for individuals, given the presence of factors such as poverty, inadequate infrastructure, high prices, and elevated transaction costs, as discussed by (Ericksen et al. 2011).

Utilization encompasses various factors that determine the capacity to effectively use food, with a particular focus on access to clean water and sanitation facilities. Additionally, it involves the consequences of inadequate food utilization, including nutritional deficiencies observed in children under the age of five, such as wasting, stunting, and being underweight (Maulina et al. 2022). Climate change exerts a detrimental impact on food utilization by affecting human health and facilitating the proliferation of diseases and pests, as emphasized by (Edame et al. 2011). Furthermore, it has adverse consequences on food safety, intensifying the pressure from vectors and increasing the incidence of water and foodborne diseases. These climate-induced effects ultimately impede individuals' ability to make effective use of the available food resources, as noted in studies by (Behnassi and Haiba 2022).

Beyond food availability and access to food, food utilization is influenced by a range of additional factors, including food preparation practices, nutritional composition, access to safe drinking water, healthcare services, maternal and child care, as well as the roles of women, as indicated by (Mengesha et al. 2023). This encompasses aspects such as hygiene, sanitation, correct food handling and processing, and a sound understanding of nutrition, in line with the insights provided by (Chik et al. 2023).

Stability pertains to the consistent accessibility of sufficient food quantities for populations, households, or individuals at all times. It serves as a metric for assessing food security risk, incorporating factors like the cereal dependency ratio, the extent of irrigated land, and the value of staple food imports as a percentage of total merchandise exports. Additionally, it is susceptible to influences such as fluctuations in domestic food prices, variations in the domestic food supply, and political instability. These factors are intricately connected with the variable weather conditions and the impacts of climate change (Kapulu et al. 2023).

Climate change exerts intricate effects on all aspects of food security. Severe climatic conditions, encompassing excessive rainfall, drought, temperature extremes, and humidity fluctuations, significantly contribute to both pre-harvest and post-harvest food losses, as highlighted by (Schuster et al. 2018). Additionally, infestations by pests and outbreaks of diseases represent significant factors driving food loss and waste, subsequently undermining food availability (Schuster et al. 2018).

Furthermore, climate change impacts transportation through the deterioration of infrastructure, diminishes purchasing power due to escalating food prices, fosters the proliferation of water and foodborne diseases, and reduces yields due to the occurrence of extreme climatic events, as elucidated by (Awange 2022). These multifaceted repercussions underscore the complex and far-reaching consequences of climate change on food security.

In Sub-Saharan Africa (SSA), there is already a discernible pattern of notable shifts in average temperatures, alterations in rainfall patterns, including both the amount and distribution of rainfall, and an upsurge in extreme weather events like droughts and floods. These climate-related transformations result in a notable decline in agricultural production potential, leading to significant reductions in crop yields. Moreover, these changes intensify the risk of food shortages and have a pervasive impact on all facets of food security, as pointed out by (Kotir 2011).

The region has faced significant challenges, including severe flooding in West Africa, prolonged and intensified droughts in East Africa, the depletion of equatorial rainforests in equatorial parts of the continent, and issues related to ocean acidification. These extreme events pose substantial threats to agricultural production and food security. Furthermore, their ramifications extend to encompass health concerns, limited access to clean water, infrastructure damage, and the heightened potential for political instability and conflicts, as articulated in (Besada et al. 2009).

Sub-Saharan Africa exhibits a noticeable lack of advancement when it comes to enhancing food security across various indicators. This is underscored by the notable prevalence of stunted and underweight children under the age of five, as indicated in the FAO's 2018 report. The region grapples with limited progress in terms of improving access to clean drinking water, sanitation facilities, as well as the quality and diversity of diets among the impoverished population. Among the four dimensions of food security, the aspect of food stability displays the slowest rate of improvement. This is primarily attributed to ongoing challenges such as political instability, armed conflicts, and civil unrest, as highlighted in reports by FAO in 2018.

Climate change exerts both direct and indirect effects on all four dimensions of food security: availability, access, utilization, and stability, as underscored by (Gitz et al. 2016). Empirical evidence dating back to 1990 demonstrates the substantial impact of climate change on these food security dimensions, with availability, access, utilization, and stability being affected to varying degrees, representing approximately 70%, 11.9%, 13.9%, and 4.2%, respectively.

Projections indicate that climate change could result in an 11% increase in the number of malnourished children by 2050 in low-income developing countries when compared to a scenario without climate change or perfect mitigation measures in place. Specifically, in Sub-Saharan Africa (SSA), the impact of climate change has already exacerbated the number of malnourished children, with projections indicating an additional 1 million malnourished children in 2030 and an additional 600,000 by 2050 when contrasted with a scenario in which climate change does not occur, as reported in studies by (Agostoni et al. 2023).

Africa faces significant vulnerability to the repercussions of climate change, posing a substantial threat to its endeavors to secure food and promote economic development, as underscored in the findings by (Firdaus et al. 2020). Paradoxically, Africa contributes to less than 7% of global greenhouse gas emissions, a relatively modest share in the context of historical emissions records. According to the World Bank's estimates in 2011, developing countries, as a whole, and specifically Sub-Saharan Africa (SSA) would require substantial financial resources to adapt to a projected temperature increase of 2 degrees Celsius by 2050. Developing nations would necessitate an estimated annual investment ranging between US$75 billion and US$100 billion, whereas SSA alone would require an annual investment within the range of US$14 billion to US$17 billion to undertake these necessary adaptation measures.

Furthermore, climate stress amplifies the occurrence and prevalence of pests and diseases, as indicated by (Teshome et al. in 2020). An illustrative example is the increased spread of malaria in regions where it was previously uncommon, particularly in areas that were cooler 50 years ago, as highlighted by (Besada et al. 2009). In Sub-Saharan Africa, diseases like malaria and other vector-borne illnesses can exert a substantial impact on labor productivity, potentially ensnaring many countries in a detrimental cycle characterized by disease, reduced productivity, poverty, and inadequate healthcare, as illuminated by (Gallup et al. 1999).

III. Methodology

This study employs a panel data research design, exclusively relying on secondary data obtained from all Sub-Saharan African nations. The dataset encompasses various categories of information, encompassing climate variables, economic metrics, and food security indicators, spanning a comprehensive 30-year period, from 1990 to 2019.

In this research, unbalanced panel data is employed for statistical analysis. The empirical examination relies on panel data sourced from Sub-Saharan African countries. As for the data sources, temperature and precipitation data are gathered from the World Bank Climate Change Portal website. To compensate for the unavailability of data for the years 2017 and 2018, a two-year moving average is computed for the climate variables using Stata.

Food security indicator variables, including metrics like access to clean water for the population, food supply variability, GDP per capita, the food production index, and the percentage of irrigated land, are sourced from datasets provided by the Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT), the World Bank's World Development Indicator, and the Our World in Data database.

Descriptive data analysis techniques, such as calculating means and standard deviations, are employed to assess the impact of variables. Additionally, regression analyses are conducted to examine the relationships between dependent and independent variables. The findings are then conveyed through textual explanations, tables, and graphical representations. For the analysis of quantitative data, Stata and EViews software packages are utilized.

IV. Model Specification

The study employed Ordinary Least Square (OLS) regression analyses to assess the influence of climate change on food security in Sub-Saharan African countries.

$$M = \alpha_0 + \alpha_1 A + \alpha_2 B + \alpha_3 C + \alpha_4 D + \alpha_5 E + \alpha_6 F + \alpha_7 G + \varepsilon \quad (1)$$

Where :

Table 1 : description of the variables

Variables	Description
M	Expressing the prevalence of undernourishment as an indicator of food insecurity.

A	Indicates the variability of yearly precipitation from its historical mean as the coefficient of variation.
B	Expresses the coefficient of variation for annual temperature relative to its historical average.
C	Depicts a food production index that measures the accessibility of food.
D	GDP per capita serves as an indicator of economic capacity to access food through purchasing power.
E	Reflects the proportion of the population with access to improved drinking water as an assessment of food utilization.
F	Quantifies the variability in food supply, assessing its stability.
G	Indicates the proportion of agricultural land with irrigation infrastructure, measuring the stability aspect of food production.
ε	the error term

V. Results And Discussions

Table 2 below presents a summary of descriptive statistics for the variables employed in the model. It includes the maximum, minimum values, average and standard deviation, for each variable considered in the analysis.

Table 2 : Summary of indicators and variables

Max	Min	Average	standard deviation
76.8	0.5	26.1	14.6
206.9	37.03	97.15	27.73
41249.4	436.7	4389.4	5476.56
99.9	13.2	64.9	18.5
184	3	41.7	26.77
100	0.1	9.4	20.33
14.15	-3.18	3.14	2.78
110.47	-72.17	-1.9	16.55

Statistical examinations are conducted to assess the model's resilience, error term attributes, enduring associations among variables, and to select the most suitable model for the regression analysis. To address the detected issues of autocorrelation, heteroskedasticity, and cross-sectional dependency in the statistical tests, the Driscoll-Kraay estimator is employed to calculate consistent standard errors within the regression. Furthermore, the regression analysis employs a random effects model, a choice supported by the Hausman test.

Table 3 provides a summary of the panel data analysis employing a random effects model to investigate the influence of climate change on food security in Sub-Saharan Africa (SSA), as outlined in Equation (1). The findings reveal that climate variables, specifically the coefficient of variation in temperature and precipitation, have a positive impact on food insecurity. Notably, the temperature coefficient of variation is statistically significant at the 1% level of significance. Holding all other factors constant, a 1% increase in the temperature coefficient of variation results in a 0.27% increase in food insecurity. Similarly, there is a noteworthy positive association between precipitation variability and food insecurity, which is statistically significant at the 10% level of significance. Maintaining other variables constant, a 10% escalation in precipitation unpredictability leads to a 0.34% growth in food insecurity.

Table 3 : the random effect panel data analysis for climate change's impact on food security in the SSA

coef	T-Ratio	Str error	Probability
-0.1287948	-9.60	0.0134	0.000
-0.00062	-2.02	0.0003	0.071
-0.18899	-5.6	0.0334	0.000
-0.01445	-0.2	0.0072	0.846
-0.11926	-1.01	0.1176	0.335
0.27342	4.06	0.0674	0.002
0.34659	2.2	0.0156	0.051
52.8636	33.4	1.5812	0.000
0.30			
418			

The food production index exerts a noteworthy and inverse influence on the prevalence of undernourishment. This suggests that as food production increases, food insecurity decreases. Specifically, a one-unit rise in food production results in a 0.12 percentage point reduction in the level of food insecurity, assuming all other factors remain constant. GDP per capita, indicative of people's purchasing power, measures economic accessibility to food. It also has a statistically significant impact on reducing the prevalence of undernourishment, with a significance level of 10%. This means that a one-dollar increase in income leads to a 0.06 percentage point decrease in food insecurity, while other variables remain unchanged.

Access to clean water sources has a noteworthy impact on reducing food insecurity, with statistical significance at the 1% confidence level. Specifically, a 1% increase in access to clean water sources leads to a corresponding decrease of approximately 0.2% in food insecurity, all other factors being held constant. Interestingly, the percentage of land suitable for irrigation and the prevalence of food supply fluctuations do not exhibit a significant impact, potentially suggesting that the utilization of irrigation and the available data in the region are not particularly influential factors in this context.

VI. Conclusion

In this study, an examination is conducted on how climate change influences food security by employing panel data encompassing Sub-Saharan African (SSA) countries spanning from 1990 to 2019. The research delves into the ramifications of climate-related variables and food security metrics on the prevalence of undernourishment in the SSA region. The findings reveal that fluctuations in temperature and precipitation have an adverse impact on food security. Both temperature and precipitation variability are statistically significant factors that detrimentally affect food security. Conversely, food security indicators such as the food production index, GDP per capita, and people's access to clean water exhibit positive associations with food security, effectively playing a significant role in enhancing food security within the region.

Climate change exerts a detrimental impact on food security, both through direct consequences on food production, closely tied to agricultural output, and indirect effects on key food security indicators. To counteract the adverse effects on food security, it is imperative to employ efficient irrigation practices, particularly in response to water scarcity and drought conditions. Additionally, in order to maintain a harmonious ecological balance, afforestation and reforestation efforts should be implemented through the cultivation of versatile agro-forest trees on unused land not designated for farming or grazing.

Furthermore, allocating resources towards agricultural research and development is critical to cultivate crop varieties that can readily adapt to local climate conditions and require minimal water for maturation. Moreover, continuous efforts to control crop pests and diseases, both in the field and during storage, are essential to prevent losses in agricultural yields. Lastly, a concerted focus on crafting and enforcing viable regulations pertaining to land use, reduction of greenhouse gas emissions, and the management of population growth is of paramount importance.

References

[01]. Alagidede, P., Adu, G. and Frimpong, P.B., (2016). The effect of climate change on economic growth: evidence from Sub-Saharan Africa. Environmental Economics and Policy Studies, 18(3), pp.417-436.

[02]. Agostoni, C., Baglioni, M., La Vecchia, A., Molari, G., & Berti, C. (2023). Interlinkages between Climate Change and Food Systems: The Impact on Child Malnutrition—Narrative Review. *Nutrients*, *15*(2), 416.

[03]. Awange, J. (2022). *Food insecurity & hydroclimate in greater horn of Africa: Potential for agriculture amidst extremes*. Springer Nature.

[04]. Behnassi, M., & El Haiba, M. (2022). Implications of the Russia–Ukraine war for global food security. *Nature Human Behaviour*, *6*(6), 754-755.

[05]. Besada, H., Lisk, F., Sewankambo, N., Kabasa, J.D., Sage, I., Willms, D., Werner, K., Orach, C.G., Isingoma, J.B. and Shaw, E., (2009). Climate change in Africa: Adaptation, mitigation and governance challenges.

[06]. Bozsik, N., Cubillos T, J. P., Stalbek, B., Vasa, L., & Magda, R. (2022). Food security management in developing countries: Influence of economic factors on their food availability and access. *PloS one*, *17*(7), e0271696.

[07]. Chik, C. T., Shahed, N. S. M., Bachok, S., Shahril, A. M., & Shamsuddin, N. (2023). Food Handlers' Food Safety Knowledge, Attitudes, and Practices in Taman Negara, Kuala Tahan.

[08]. Edame, G.E., Ekpenyong, A.B., Fonta, W.M. and Duru, E.J.C., (2011). Climate change, food security and agricultural productivity in Africa: Issues and policy directions. International journal of humanities and social science, 1(21), pp.205-223.

[09]. Ericksen, P.J., Thornton, P.K., Notenbaert, A.M.O., Cramer, L., Jones, P.G. and Herrero, M.T., (2011). Mapping hotspots of climate change and food insecurity in the global tropics.

[10]. FAO, F., (2013). Statistical yearbook. World Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome. pp, 289.

[11]. FAO. (2016). The state of food and agriculture. Climate change, agriculture and food security. Rome, Italy

[12]. FAO. 2018. The State of Food and Agriculture (2018). Migration, agriculture and rural development. Rome. Licence: CC BY-NC-SA 3.0 IGO.

[13]. Firdaus, R. R., Leong Tan, M., Rahmat, S. R., & Senevi Gunaratne, M. (2020). Paddy, rice and food security in Malaysia: A review of climate change impacts. *Cogent Social Sciences*, *6*(1), 1818373.

[14]. Gallup, J.L., Sachs, J.D. and Mellinger, A.D., (1999). Geography and economic development. International regional science review, 22(2), pp.179-232.

[15]. Gitz, V., Meybeck, A., Lipper, L., Young, C.D. and Braatz, S., (2016). Climate change and food security: risks and responses. Food and Agriculture Organization of the United Nations (FAO) Report, 110.

[16]. Kapulu, N. P., Clark, H., Manda, S., Smith, H. E., Orfila, C., & Macdiarmid, J. I. (2023). Evolution of energy and nutrient supply in Zambia (1961–2013) in the context of policy, political, social, economic, and climatic changes. *Food Security*, *15*(2), 323-342.

[17]. Kotir, J.H., (2011). Climate change and variability in Sub-Saharan Africa: a review of current and future trends and impacts on agriculture and food security. Environment, Development and Sustainability, 13(3), pp.587-605.

[18]. Kurmi, A., Jayswal, D. K., Saikia, D., & Lal, N. (2023). Current Perspective on Malnutrition and Human Health. In *Nano-Biofortification for Human and Environmental Health* (pp. 155-177). Cham: Springer International Publishing.

[19]. Lara-Arévalo, J., Escobar-Burgos, L., Moore, E. R. H., Neff, R., & Spiker, M. L. (2023). COVID-19, Climate Change, and Conflict in Honduras: A food system disruption analysis. *Global Food Security*, 100693.

[20]. Maulina, R., Qomaruddin, M. B., Kurniawan, A. W., Fernandes, A., & Astuti, E. (2022). Prevalence and predictor stunting, wasting and underweight in Timor Leste children under five years: An analysis of DHS data in 2016. *Journal of Public Health in Africa*, *13*(2).

[21]. Mengesha, E. W., Tessema, G. A., Assefa, Y., & Alene, G. D. (2023). Social capital and its role to improve maternal and child health services in Northwest Ethiopia: A qualitative study. *Plos one*, *18*(4), e0284592.

[22]. Raihan, A., Muhtasim, D. A., Farhana, S., Hasan, M. A. U., Pavel, M. I., Faruk, O., ... & Mahmood, A. (2022). Nexus between economic growth, energy use, urbanization, agricultural productivity, and carbon dioxide emissions: New insights from Bangladesh. *Energy Nexus*, *8*, 100144.

[23]. Schuster, M., Delgado, L. and Torero, M., 2018. The Reality of Food Losses: A New Measurement Methodology. IFPRI Discussion Paper 01686.Washington, DC.Singh, M. J., & Iwatt, E. B. (2023). Factors Affecting Smallholder Farmers' Well-being: A Systematic Review. *Asia-Africa Journal of Academic Research and Review*, *3*(2).

[24]. Shahzad, A., Ullah, S., Dar, A. A., Sardar, M. F., Mehmood, T., Tufail, M. A., ... & Haris, M. (2021). Nexus on climate change: Agriculture and possible solution to cope future climate change stresses. *Environmental Science and Pollution Research*, *28*, 14211-14232.

[25]. Teshome, D. T., Zharare, G. E., & Naidoo, S. (2020). The threat of the combined effect of biotic and abiotic stress factors in forestry under a changing climate. *Frontiers in plant science*, *11*, 1874.

[26]. Thompson, J. A. M. (2023). Environmental and Social Impacts of Agricultural Biodiversity Degradation from the Ultra-Processed Food Industry. *InterNaciones*, (24), 141-164.

[27]. World Health Organization, (2019). The state of food security and nutrition in the world 2019: Safeguarding against economic slowdowns and downturns (Vol. 2019). Food & Agriculture Org.

[28]. World bank.(2011) Provision of Nutrition Interventions for the most vulnerable and ensuring access to humanitarian supplies: progress and prospects. Report to G20 development working Group: Food security pillar: June 3rd 2011.