



## SRMUN ATLANTA 2020

*Understanding and Combating Global Multidimensional Poverty and Inequality*

October 23-25, 2020

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Greetings Delegates,

Welcome to Virtual SRMUN Atlanta 2020 and The Food and Agriculture Organization (FAO). My name is Rachael Wnuk, and I will be serving as your Director for the FAO. This will be my fourth conference as a SRMUN staff member. Previously, I served as the Director to the Human Rights Council and the United Nations High Commissioner for Refugees Executive Committee, and an Assistant Director to the World Health Organization. I received my Bachelors in Education from the University of North Florida in 2018, after having taught abroad in both Belize and Uganda. Our committee's Assistant Director will be Kathleen Conow and Daniel Felberg. This will be Kathleen's second year serving as an Assistant Director at SRMUN Atlanta, having previously served with Security Council, and also served as an General Assembly Plenary Assistant Director at SRMUN Charlotte. This will be Daniel's inaugural year serving as an Assistant Director at SRMUN Atlanta, but has previously served as a Chairperson with the International Atomic Energy Agency at SRMUN Atlanta 2019. Currently, Kathleen and Daniel are both working towards a bachelor's degree in both Political Science and International Studies. Daniel and Kathleen are hopeful that their extensive academic and MUN backgrounds will be of service to the delegates of the FAO at Virtual SRMUN Atlanta.

Founded in 1945, and headquartered in Rome, Italy, the FAO is a specialized UN agency charged with eliminating hunger worldwide. With a council consisting on 49 Member States and a Conference currently composed of 197 members, which includes 194 Member States, two associate-members and one member-organization, the FAO has strived to implement its mission on a global scale. Since its founding the Organization has expanded also expanded their mission beyond ending hunger world-wide to also impact food and nutrition security, sustainable agriculture and rural development.

By focusing on the mission of the FAO and the SRMUN Atlanta 2020 theme of "*Understanding and Combating Global Multidimensional Poverty and Inequality*," we have developed the following topics for the delegates to discuss come conference:

- I. Utilizing Technology to Eliminate Food Insecurity
- II. Addressing Climate Changes Impact on the Agriculture Industry

The background guide provides a strong introduction to the committee and the topics and should be utilized as a foundation for the delegate's independent research. However, the guide should only serve as a starting point for delegates, as it is a surface level analysis of each topic. Delegates are expected to go beyond the background guide and engage in deep research on the topics, as well as their Member States' position on said topics. The position papers for the committee should reflect the complexity of these issues as well as their implications on the international community as a whole. Delegations are expected to submit a position paper and be prepared for a vigorous discussion at the conference. Position papers should be no longer than two pages in length (single spaced) and demonstrate your Member State's position, policies and recommendations on each of the two topics. For more detailed information about formatting and how to write position papers, delegates can visit [srmun.org](http://srmun.org). All position papers **MUST be submitted no later than Friday, October 2, 2020, by 11:59pm EST** via the SRMUN website in order to be eligible for Outstanding Position Paper Awards.

Daniel, Kathleen, and I are enthusiastic about serving as your dais for the FAO. We wish you all the best of luck in your conference preparation and look forward to working with you soon. Please feel free to contact Ryan, Kathleen, Daniel, or myself if you have any questions while preparing for the conference.

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## History of the Food and Agriculture Organization

Founded in October of 1945, at the first session of the United Nations (UN), the Food and Agriculture Organization (FAO), is a specialized UN agency that is in charge of eliminating hunger worldwide.<sup>1</sup> Since its establishment, it has redefined its focus to also include topics surrounding climate change and food security, such as sustainable urban food systems. More recently, the FAO has also been working towards achieving the UN Sustainable Development Goals (SDGs), in partnership with additional UN agencies and organizations. Led by Qu Dongyu, the Director-General for the FAO, the leadership of the organization is further divided amongst two Deputy Directors-General, the Assistant Directors-General, and the Regional Representatives of the Assistant Directors-General.<sup>2</sup> The FAO is composed of six different departments, each with a unique focus. These departments include: Agriculture and Consumer Protection; Economic and Social Development; Fisheries and Aquaculture; Forestry; Corporate Services, Human Resources, and Finance; and Technical Cooperation.<sup>3</sup>

Upon its founding in 1945, the Constitution of the Food and Agriculture Organization was signed, calling for “a Conference of the Organization in which each Member Nation and Associate Member shall be represented by one delegate.”<sup>4</sup> The Conference continues to be the supreme governing body of the FAO, meeting every two years at the organization's headquarters, in Rome, Italy.<sup>5</sup> Its main functions include “[determining] the policies of the Organization, [approving] the budget, and [making] recommendations to Members and international organizations on any matter pertaining to the purposes of FAO.”<sup>6</sup> The Conference is also responsible for electing 49 Member Nations of the FAO to the Council, the executive body of the organization. Meeting at least three times between regular sessions of the Conference, each Member Nation to the Council is elected for a three-year term, and every year a third of the membership stands down.<sup>7</sup> As stated in the Constitution of the FAO, “The Council, within the limits of the powers delegated to it by the Conference, acts as the Conference's executive organ between sessions. In particular, it exercises functions dealing with the world food and agriculture situation and related matters, current and prospective activities of the Organization, including its Program of Work and Budget, administrative matters and financial management of the Organization and constitutional matters.”<sup>8</sup>

Presently, the FAO is made up of 194 Member States, two associate members (Faroe Islands and Tokelau), and a member organization (the European Union), for a total of 197 members overall.<sup>4</sup> As pointed out, each Member is given one equal vote at the FAO Conference, and the same applies for the Council as well. In recent history, the FAO has implemented a series of global programmes that are successfully supporting Member States in developing and implementing policies, frameworks, and institutional arrangements required to transform policies and create an enabling environment for agricultural development. Taking into account, annually, up to 40 percent of global food crops are lost as a result of plant pests, as well as plant diseases which cost the global economy an estimated USD 220 billion annually.<sup>9</sup> The Globally Important Agricultural Heritage Systems (GIAHS) was implemented in hopes to develop safeguards and support the world's agricultural heritage systems. The FAO instituted the objective of cultivating a dynamic conservation surrounding GIAHS in 2002. Launched in 2014 and funded by the European Development Fund (EDF), the FAO has also implemented The Action Against Desertification initiative.<sup>10</sup> This

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1 “About FAO.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/en/> (Accessed February 26, 2020).

2 “Leadership.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/leadership/en/> (Accessed February 26, 2020).

3 “Who We Are.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/who-we-are/en/> (Accessed February 26, 2020).

4 “GSB: Conference.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/unfao/govbodies/gsbhome/conference/en/> (Accessed February 26, 2020).

5 “FAO Conference and FAO Council.” Food and Agriculture Organization of the United Nations, [http://www.fao.org/mfcal/i\\_faocon.htm](http://www.fao.org/mfcal/i_faocon.htm) (Accessed February 26, 2020).

6 “GSB: Conference.” Food and Agriculture Organization of the United Nations,.

7 “GSB: Council.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/unfao/govbodies/gsbhome/council/en/> (Accessed February 26, 2020).

8 “GSB: Conference.” Food and Agriculture Organization of the United Nations.

9 “Economic and Policy Analysis of Climate Change.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/climate-change/programmes-and-projects/detail/en/c/327624/>. (Accessed February 24, 2020)

10 “FAO.org” Food and Agriculture Organization of the United Nations, <http://www.fao.org/in-action/action-against-desertification/overview/en/> (Accessed March 1, 2020)

project focuses on the African, Caribbean and Pacific Group of States (ACP), in order to restore drylands and degraded lands in those regions.<sup>11</sup> This project's objective is to combat the negative impacts of the current social, economic and environmental state of land degradation and desertification.<sup>12</sup> Action Against Desertification focuses on six African Member States: Burkina Faso, Ethiopia, The Gambia, Niger, Nigeria and Senegal, as well as Fiji, and Haiti.<sup>13</sup>

On December 20, 2018, the FAO devoted the entire year to issues in nutrition and global food security. Consequently, implementing an abundance of resolutions in relation to food safety and agriculture.<sup>14</sup> The FAO in conjunction with the World Health Organization (WHO), World Trade Organization (WTO), and the African Union (AU), has organized two international conferences in reference to food safety that took place in Ethiopia and Switzerland in 2019.<sup>15</sup> The organization has also implemented a variety of measures such as Land Restoration, Non-Timber Forest Products, Capacity Development, Monitoring and Evaluating, Information Sharing, and South-south cooperation.<sup>16</sup> The FAO introduced the “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.”<sup>17</sup> An initiative guided by the Economic Community of West African States (ECOWAS) at the regional and national level.<sup>18</sup> This project has assisted in decreasing the detrimental impacts that droughts have had towards the Senegal River Basin’s population, as well as improving the livelihood of the population.<sup>19</sup> This initiative's objective is to enhance tools for multi-objective water resource management, development of hydro-economic modelling for the Senegal Basin and sub-basins, and identifying cross-boundary investment areas to improve collaboration in the administration of water sources.<sup>20</sup> Following these initiatives, the FAO will monitor the success of each.<sup>21</sup>

The FAO has recently also implemented Climate Adaptation in Wetland Areas of Lao PDR (CAWA) project that relies on an Ecosystem-Based Adaptation (EBA) approach which provides the ability for the wetlands that are used to act as a buffer to the livelihood of local communities in Lao PDR against climate change impacts. The CAWA is safeguarded through the combination of improved planning as well as governance conditions, direct investments in climate change adaptation measures, and activities aimed to strengthen the surrounding communities livelihoods.<sup>22</sup> The CAWA focuses on three main factors; the first being planning in conjunction with science, and regionally-based knowledge that pertains to vulnerability assessments. Such an assessment is intended to be conducted through interviews and informal meetings with the Laotians. It is the hope that the result of said meetings will allow for further understanding of the impact that climate change has had in Lao PDR, as well as the impacts and risks Laotians continue to face.<sup>23</sup> The second being the adaptation of policies, such as efficient and cost-effective measures in order to reduce the impact of climate change and natural disasters on wetland ecosystems, as well as local livelihoods. In order to do this, the FAO is looking at options involving land use planning, community and social adaptation, engineering solutions, and diverse best practice options conducive to ensuring a sustainable

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11 “FAO.org” Food and Agriculture Organization of the United Nations.

12 “FAO.org” Food and Agriculture Organization of the United Nations.

13 “FAO.org” Food and Agriculture Organization of the United Nations.

14 “The State of Food and Agriculture 2016 (SOFA): Climate Change, Agriculture and Food Security.” Food and Agriculture Organization of the United Nations. <http://www.fao.org/resilience/resources/resources-detail/en/c/1114122/>. (Accessed February 24, 2020)

15 “Economic and Policy Analysis of Climate Change.” Food and Agriculture Organization of the United Nations. <http://www.fao.org/climate-change/programmes-and-projects/detail/en/c/327624/>. (Accessed February 24, 2020)

16 “FAO.org.” Food and Agriculture Organization of the United Nations. <http://www.fao.org/in-action/action-against-desertification/overview/en/>. (Accessed March 1, 2020)

17 “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.” Food and Agriculture Organization of the United Nations. <http://www.fao.org/in-action/senegal-basin-project/en/>. (Accessed March 1, 2020)

18 “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.” Food and Agriculture Organization of the United Nations.

19 “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.” Food and Agriculture Organization of the United Nations.

20 “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.” Food and Agriculture Organization of the United Nations.

21 “Enhanced Cross-Boundary Water Resource Management in the Senegal River Basin.” Food and Agriculture Organization of the United Nations.

22 “Climate Adaptation in Wetland Areas of Lao PDR (CAWA)” Food And Agriculture Organization of the United Nations.. <http://www.fao.org/climate-change/programmes-and-projects/detail/en/c/1109742/>. (Accessed February 24, 2020)

23 “Climate Adaptation in Wetland Areas of Lao PDR (CAWA)” Food And Agriculture Organization of the United Nations.

livelihood for the people of Lao PDR.<sup>24</sup> Finally, the CAWA strives to achieve the implementation of institutional mechanisms and structures regarding integration of climate change adaptation and disaster management planning processes.<sup>25</sup>

The FAO is supporting Member States through a wide range of research, education, practical programmes and projects.<sup>26</sup> As the organization progresses, it will continue to combat the most significant challenges to the international community, and provide holistic solutions following widespread participation.<sup>27</sup> The FAO Deputy Director-General Maria Helena Semedo has said, "The International Year of Plant Health is a key initiative to highlight the importance of plant health to enhance food security, protect the environment and biodiversity, and boost economic development."<sup>28</sup> Along with the International Plant Protection Convention Secretariat (IPPC), the FAO established 2020 as the International Year of Plant Health.<sup>29</sup> As well as, also dedicating June 7<sup>th</sup> as World Food Safety Day. The FAO has acknowledged that "there is no food security without food safety."<sup>30</sup> Globally, there are over 200 diseases as a result of food that is unsafe for consumption. The organization has been working with Member States to encourage the global compliance of requirements and contributions to food safety through this initiative.<sup>31</sup> Overall, from the very beginning, they have worked on numerous issues and have partnered with numerous UN agencies and organizations to deal with issues that involve agriculture and food for Member States around the world. The FAO is determined to develop resolutions for those affected, to encourage Member States to be more resilient, decrease the effects of global climate change, increase food security, and guide the international community in meeting the 2030 Sustainable Development Goals.

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24 "Climate Adaptation in Wetland Areas of Lao PDR (CAWA)" Food And Agriculture Organization of the United Nations.

25 "Climate Adaptation in Wetland Areas of Lao PDR (CAWA)" Food And Agriculture Organization of the United Nations.

26 "FAO's Programme Work." Food and Agriculture Organization of the United Nations. <http://www.fao.org/climate-change/programmes-and-projects/en/>. (Accessed February 24, 2020)

27 "FAO's Programme Work." Food and Agriculture Organization of the United Nations.

28 "Economic and Policy Analysis of Climate Change." Food and Agricultural of the United Nations. <http://www.fao.org/climate-change/programmes-and-projects/detail/en/c/327624/>. (Accessed February 24, 2020)

29 The State of Food and Agriculture 2016 (SOFA): Climate Change, Agriculture and Food Security." Food and Agriculture Organization of the United Nations. <http://www.fao.org/resilience/resources/resources-detail/en/c/1114122/>. (Accessed February 24, 2020)

30 "Economic and Policy Analysis of Climate Change." Food and Agricultural of the United Nations. <http://www.fao.org/climate-change/programmes-and-projects/detail/en/c/327624/>. (Accessed February 24, 2020)

31 "Economic and Policy Analysis of Climate Change." Food and Agricultural of the United Nations

# I. Utilizing Technology to Eliminate Food Insecurity

## *Introduction*

According to the Food and Agriculture Organization (FAO), “food insecurity” occurs when “[a person] lack[s] regular access to enough safe and nutritious food for normal growth and development and an active and healthy life.”<sup>32</sup> It is important to note that food insecurity spans more than hunger and malnutrition.<sup>33</sup> It also includes issues such as obesity, which is recognized as an indication of a poor and unbalanced diet, as well as lack of sustainable agriculture.<sup>34</sup> As such, the FAO believes agricultural innovation is the crucial way forward in reducing the number of people who suffer from food insecurity.<sup>35</sup> Agricultural innovation is identified as:

*“the process whereby individuals or organizations bring new or existing products, processes or ways of organization into use for the first time in a specific context in order to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to food security and nutrition, economic development or sustainable natural resource management.”<sup>36</sup>*

Therefore, while agricultural innovation incorporates a number of different aspects, and ways to innovate within the field of agriculture, technology, on its own, is only a component of the aforementioned innovation strategies.

Currently, over 820 million individuals suffer from some form of food insecurity, and no region is immune from the obesity epidemic.<sup>37</sup> Of those, it is estimated that around 704 million suffer from severe food insecurity, meaning they have gone at least one day without eating or may have even run out of food.<sup>38</sup> Asia alone is home to more than 350 million people suffering from severe food insecurity, the highest number in any region.<sup>39</sup> Additionally, over two billion people suffer from moderate food security, where “people [...] face uncertainties about their ability to obtain food, and have been forced to compromise on the quality and/or quantity of the food they consume.”<sup>40</sup> Although moderate food security is not, by definition, as serious as severe food insecurity, it is still a driving cause for obesity globally.<sup>41</sup>

## *History*

After the end of World War II, many Member States’ economies were devastated and there was a concern widespread famines would occur, thus making it necessary to have a better understanding of the state of nutrition around the world.<sup>42</sup> Soon after its establishment in 1945, the FAO was tasked with conducting the first ever World Food Survey in 1946.<sup>43</sup> It included 70 Member States and was one of the first attempts in history to create a comprehensive world-wide measurement of the state of nutrition around the world.<sup>44</sup> Later in 1950, the World

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<sup>32</sup> “Hunger and Food Insecurity.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/hunger/en/> (Accessed March 26, 2020).

<sup>33</sup> “Hunger and Food Insecurity.” Food and Agriculture Organization of the United Nations.

<sup>34</sup> “Hunger and Food Insecurity.” Food and Agriculture Organization of the United Nations.

<sup>35</sup> “Hunger and Food Insecurity.” Food and Agriculture Organization of the United Nations.

<sup>36</sup> “About the Symposium.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/meetings/agricultural-innovation-family-farmers-symposium/about/en/> (Accessed March 24, 2020).

<sup>37</sup> “The State of Food Security and Nutrition in the World.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/state-of-food-security-nutrition> (accessed July 11, 2020)

<sup>38</sup> “The State of Food Security and Nutrition in the World.” Food and Agriculture Organization of the United Nations.

<sup>39</sup> “The State of Food Security and Nutrition in the World.” Food and Agriculture Organization of the United Nations.

<sup>40</sup> “The State of Food Security and Nutrition in the World.” Food and Agriculture Organization of the United Nations.

<sup>41</sup> “The State of Food Security and Nutrition in the World.” Food and Agriculture Organization of the United Nations.

<sup>42</sup> “About FAO.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/en/> (Accessed April 30, 2020).

<sup>43</sup> “About FAO.” Food and Agriculture Organization of the United Nations.

<sup>44</sup> “About FAO.” Food and Agriculture Organization of the United Nations.

Census of Agriculture was created to help Member States with their own national agriculture censuses using internationally-recognized parameters, definitions, and methodologies.<sup>45</sup> Throughout the 20<sup>th</sup> century, the FAO would conduct five more World Food Surveys, with the last one being published in 1996.<sup>46</sup> That year, in its place, the FAO adopted the Rome Declaration on World Food Security at the World Food Summit.<sup>47</sup> This document was signed by 112 heads of state and an additional 70 high-level representatives, and was intended to reaffirm the universal right to safe and nutritious food and to continue to work towards eradicating hunger.<sup>48</sup> The following year, the FAO Conference adopted Resolution 6/97, *Strengthening the FAO 2000 Project*, during its 29<sup>th</sup> session.<sup>49</sup> This resolution built upon the momentum from the Rome Declaration and mobilized the FAO's administration and resources to put together a plan to implement the World Food Summit Plan of Action, whereby 2015, the goal would be to reduce the number of undernourished people by half.<sup>50</sup>

### ***Current Situation***

Alongside the FAO, the United Nations (UN) has continuously worked towards eliminating food insecurity through the second Sustainable Development Goal (SDG2): Zero Hunger.<sup>51</sup> The goal recognizes, "Better use of agricultural biodiversity can contribute to more nutritious diets, enhanced livelihoods for farming communities and more resilient and sustainable farming systems."<sup>52</sup> This SDG acknowledges there has been a significant loss, approximately 75 percent, in crop diversity from farmers' fields since the 1900s, and seeks to promote greater food security and sustainable agriculture by increasing the productivity of small-scale producers, and ensuring that food production systems help maintain ecosystems, and strengthen adaptation capacity to climate change.<sup>53</sup>

Since 2014, the FAO has been utilizing the Food Insecurity Experience Scale (FIES), which is an "experience-based metric of food insecurity severity" that uses people's direct responses.<sup>54</sup> It allows the FAO to identify needs of different regions via simple questions, which can then be used by governments, organizations, or others, to conduct the survey themselves. The FAO recognizes that "because the FIES is easy for professionals and institutions from any sector to use, its inclusion in diverse types of surveys can help strengthen links between different sectorial perspectives, for example, between agriculture, social protection, health and nutrition."<sup>55</sup> Alongside the FIES, the FAO also relies on two other indicators: the Prevalence of Undernourishment (PoU) and the Prevalence of Moderate to Severe Food Insecurity in the Population, which is based on the FIES.<sup>56</sup> Each of these indicators has its own set of methodologies, and present varying perspectives to measure the world's progress towards achieving the goals laid out in SDG2.<sup>57</sup> Using the PoU, the FAO estimated that since 2005, the number of people suffering from hunger, otherwise classified as undernourishment, had decreased from 947.2 million, to 811.7 million in 2017.<sup>58</sup>

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<sup>45</sup> "About FAO." Food and Agriculture Organization of the United Nations.

<sup>46</sup> "The Sixth – World Food Survey." Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/w0931e/w0931e00.htm> (Accessed April 30, 2020).

<sup>47</sup> "About FAO." Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/en/> (Accessed April 30, 2020).

<sup>48</sup> "About FAO." Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/en/> (Accessed April 30, 2020).

<sup>49</sup> Conference of the United Nations Food and Agriculture Organization, Resolution 6/97, *Strengthening the FAO 2000 project*, November 18, 1997, <http://www.fao.org/docrep/W7475E/W7475e08.htm - Resolution6>

<sup>50</sup> Conference of the United Nations Food and Agriculture Organization, Resolution 6/97, *Strengthening the FAO 2000 project*, November 18, 1997.

<sup>51</sup> "Goal 2: Zero Hunger." United Nations, <https://www.un.org/sustainabledevelopment/hunger/> (Accessed March 27, 2020).

<sup>52</sup> "Goal 2: Zero Hunger." United Nations.

<sup>53</sup> "Goal 2: Zero Hunger." United Nations.

<sup>54</sup> "Voices of the Hungry." Food and Agriculture Organization of the United Nations, <http://www.fao.org/in-action/voices-of-the-hungry/background/en/> (Accessed April 25, 2020).

<sup>55</sup> "The Food Insecurity Experience Scale." Food and Agriculture Organization of the United Nations, <http://www.fao.org/in-action/voices-of-the-hungry/fies/en/> (Accessed March 26, 2020).

"Hunger and Food Insecurity." Food and Agriculture Organization of the United Nations, <http://www.fao.org/hunger/en/> (Accessed March 26, 2020).

<sup>57</sup> Hunger and Food Insecurity." Food and Agriculture Organization of the United Nations.

<sup>58</sup> Hunger and Food Insecurity." Food and Agriculture Organization of the United Nations.

Many of the actions taken by the FAO when it comes to agricultural innovations have revolved around family farmers and smallholders, such as “small-scale farmers, pastoralists, forest keepers, [and] fishers”, as they are vital for economies and food systems.<sup>59</sup> As identified in SDG2, not only is agriculture the largest source of income and jobs for poor rural households, but also, “500 million small farms worldwide, [...] provide up to 80 percent of food consumed in a large part of the developing world”.<sup>60</sup> In response, the organization hosted the International Symposium on Agricultural Innovation for Family Farmers at its headquarters in Rome in November of 2018.<sup>61</sup> With an attendance of over 540 participants, 92 of which were representatives from Member States and other key stakeholders in agricultural innovation, it recognized the key role that family farmers play in agricultural innovation.<sup>62</sup> Overall, the Symposium served as a forum to exchange ideas, and bring forward innovations that can mainly serve to help family farmers and their communities.<sup>63</sup>

### ***Mechanization***

A key component of agricultural innovation that demonstrates the benefits of technology in agriculture is mechanization. The FAO has defined mechanization as “the process of improving farm labor productivity through the use of agricultural machinery, implements and tools”.<sup>64</sup> This can include all levels of farming technologies, from more basic tools, such as hand hoes, to more modern machinery, such as tractors.<sup>65</sup> Mechanization eases and reduces hard labor and relieves labor shortages.<sup>66</sup> These occur where there is a demand for labor in specific sectors of the economy, but that demand cannot be met, mainly due to specific limitations of individuals.<sup>67</sup> For example, many developing Member States labor shortages in sectors outside of agriculture precisely because large portions of their populations work in small and family farms.<sup>68</sup>

It is estimated that using a hand hoe could take up to 60 days to cultivate a hectare of land.<sup>69</sup> This time is reduced drastically to three days if one were to use animal-powered tools instead, and to less than a day when using a powered direct seeder.<sup>70</sup> It is not only in agricultural sectors though that the benefits of mechanization can be observed. Zambia was able to attain approximately 25 to 35 percent in labor savings, specifically by reducing the number of people required for farming, after it began using animal-powered equipment.<sup>71</sup> For women especially, this can have enormous benefits, as they contribute around 80 percent of total farm labor in many farming-based communities, and increased mechanization can reduce their workload.<sup>72</sup> With more time to spare, smallholder farm

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<sup>59</sup> “Smallholders and Family Farmers.” Food and Agriculture Organization of the United Nations, [http://www.fao.org/fileadmin/templates/nr/sustainability\\_pathways/docs/Factsheet\\_SMALLHOLDERS.pdf](http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf) (Accessed July 11, 2020).

<sup>60</sup> “Goal 2: Zero Hunger.” United Nations, <https://www.un.org/sustainabledevelopment/hunger/> (Accessed March 27, 2020).

<sup>61</sup> Innovation at FAO.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/innovation/en/> (Accessed March 24, 2020).

<sup>62</sup> “Innovation at FAO.” Food and Agriculture Organization of the United Nations.

<sup>63</sup> “Innovation at FAO.” Food and Agriculture Organization of the United Nations.

<sup>64</sup> “Mechanization.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/tc/exact/sustainable-agriculture-platform-pilot-website/energy-management/mechanization/en/> (Accessed April 30, 2020).

<sup>65</sup> “Mechanization.” Food and Agriculture Organization of the United Nations.

<sup>66</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/CA2460EN/ca2460en.pdf> (Accessed May 18, 2020).

<sup>67</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>68</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>69</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>70</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>71</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>72</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

families are able to more easily find off-farm employment opportunities, giving women access to more economic opportunities.<sup>73</sup>

It is important to note that while mechanization has contributed to many advancements in agriculture, it must be approached carefully because other factors, such as costs and training, can play a role as to how feasible its implementation can be.<sup>74</sup> The long-term goal for the use of mechanization is for it to contribute towards sustainable agricultural production, meaning costs and environmental impacts can affect food production, and consequently, food security.<sup>75</sup> Therefore, the choices made by local farmers and smallholders as to what tools they prefer to use can vary based on local circumstances, and farmers themselves can choose to use more than one option if they prefer to do so.<sup>76</sup> Sustainable agricultural mechanization can contribute significantly to developing food chains and systems, and increasing food security as a whole.<sup>77</sup> Additionally, the FAO points out that sustainable mechanization can:

*“increase land productivity by facilitating timeliness and quality of cultivation; support opportunities that relieve the burden of labor shortages and enable households to withstand shocks better; decrease the environmental footprint of agriculture when combined with adequate conservation agriculture practices; and reduce poverty and achieve food security while improving people's livelihoods.”*<sup>78</sup>

Indonesia is one example where mechanization has become a growing trend in its agricultural sector.<sup>79</sup> From 1998 to 2002, it is estimated that the number of irrigation pumps used in farms rose by about 17.5 percent (from 117,340 in 1998 to 216,643 in 2002).<sup>80</sup> The increased use of irrigation pumps has allowed Indonesian farmers to increase their income by generating a larger amount of crops.<sup>81</sup> In addition, farmers also gained greater awareness of the impacts they have on water quality and availability.<sup>82</sup> Furthermore, these farmers have been able to modify their strategy from protective farming, where water is used to protect their crops, to productive farming, where water is used to secure the productivity of their land, meaning their water use is more efficient.<sup>83</sup> These advancements have ultimately improved farming systems in Indonesia, thereby increasing the Member State's levels of food security.<sup>84</sup>

The FAO also sees information sharing as a vital aspect of increasing the levels of mechanization. With this in mind, the previously mentioned Symposium on Agricultural Innovation for Family Farmers has played a crucial role in exchanging best practices, by facilitating information sharing among individuals from various areas within the

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<sup>73</sup> “Agricultural mechanization: A key input for sub-Saharan African smallholders.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/a-i6044e.pdf> (Accessed May 30, 2020).

<sup>74</sup> “Integrating mechanization into strategies for sustainable agriculture.” Technical Centre for Agricultural and Rural Cooperation, <http://www.animaltraction.com/StarkeyPapers/Starkey-CTA-BF-MechanisationReport98.pdf> (Accessed April 30, 2020).

<sup>75</sup> “Integrating mechanization into strategies for sustainable agriculture.” Technical Centre for Agricultural and Rural Cooperation.

<sup>76</sup> “Integrating mechanization into strategies for sustainable agriculture.” Technical Centre for Agricultural and Rural Cooperation.

<sup>77</sup> “Why mechanization is important.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/sustainable-agricultural-mechanization/overview/why-mechanization-is-important/en/> (Accessed April 30, 2020).

<sup>78</sup> “Why mechanization is important.” Food and Agriculture Organization of the United Nations.

<sup>79</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations, [http://www.techmonitor.net/tm/images/d/d4/09jan\\_feb\\_sf4.pdf](http://www.techmonitor.net/tm/images/d/d4/09jan_feb_sf4.pdf) (Accessed April 30, 2020).

<sup>80</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations.

<sup>81</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations.

<sup>82</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations.

<sup>83</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations.

<sup>84</sup> “Towards sustainable agricultural mechanization in Indonesia.” Food and Agriculture Organization of the United Nations.



agriculture sector.<sup>85</sup> Summits and symposiums can allow for greater communication between different agricultural sectors and provide individuals from smaller communities bigger platforms to share their ideas with one another.<sup>86</sup>

### **Case Study**

#### *dLocust*

Over the years, a number of Member States have suffered from locust infestations and the FAO still considers the insect to be a key factor contributing to food insecurity, especially in developing Member States.<sup>87</sup> Locusts, a type of insect related to grasshoppers, can devastate crops and agriculture on a widespread scale, with each individual locust being able to eat its own weight in plants each day.<sup>88</sup> Locusts consume a wide variety of vegetation, ranging from crops and pasture to trees, however, this can vary depending on factors such as geography and climate.<sup>89</sup> Though they are related to grasshoppers, they behave differently. Locusts have a gregarious phase, where, if the environmental conditions allow it, they are able to congregate in thick swarms.<sup>90</sup> These swarms can travel anywhere between five to 130 kilometers in a day, can contain 40 to 80 million locusts in less than half a square mile, and consume the same amount of food in one day as approximately 35,000 people.<sup>91</sup> In February of 2020, it was reported that East Africa had suffered from its worst desert locust infestation in decades, with Ethiopia, Kenya, and Somalia being particularly impacted.<sup>92</sup> For Kenya, it was their worst infestation in 70 years, whereas for Somalia and Ethiopia it was their worst in 25 years.<sup>93</sup>

Since locust swarms form in large numbers and often in remote areas, such as the semi-arid and arid deserts of Africa, controlling them is extremely difficult.<sup>94</sup> Understanding the severe impact they have had on local agriculture and family farmers, the FAO has been working to develop a fixed-wing drone solution that could potentially survey vast areas for potential infestations with significantly more ease than ground teams could.<sup>95</sup> dLocust, or drone locust, would be able to fly 100 kilometers in distance, collect data on green vegetation like growth rate and types of vegetation, and send the results back to a surveying team on the ground.<sup>96</sup> This allows for areas of interest, which might show early stages of a locust swarm forming, to be highlighted more easily.<sup>97</sup> Areas with high infestation rates could then be sprayed with pesticides with more accurate precision using rotary drones, before the locusts are

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<sup>85</sup> “About the Symposium.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/meetings/agricultural-innovation-family-farmers-symposium/about/en/> (Accessed March 24, 2020).

<sup>86</sup> “About the Symposium.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/meetings/agricultural-innovation-family-farmers-symposium/about/en/> (Accessed March 24, 2020).

<sup>87</sup> “About FAO.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/about/en/> (Accessed April 30, 2020).

<sup>88</sup> “Locusts.” National Geographic, <https://www.nationalgeographic.com/animals/invertebrates/group/locusts/> (Accessed April 25, 2020).

<sup>89</sup> “Fact Sheet: Vegetable and Herbs.” Agriculture Victoria, <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/plague-locusts/fact-sheet-vegetable-and-herbs> (Accessed May 30, 2020).

<sup>90</sup> “Locusts.” National Geographic

<sup>91</sup> “Locusts.” National Geographic.

<sup>92</sup> “OCHA/FAO Briefing on the Desert Locust Situation in East Africa.” United Nations, <http://webtv.un.org/live/watch/ochafao-briefing-on-the-desert-locust-situation-in-east-africa/6131302158001/?term=> (Accessed April 25, 2020).

<sup>93</sup> “OCHA/FAO Briefing on the Desert Locust Situation in East Africa.” United Nations.

<sup>94</sup> “Frequently Asked Questions (FAQs) about locusts.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/ag/locusts/en/info/info/faq/index.html> (Accessed April 25, 2020).

<sup>95</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>96</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

<sup>97</sup> “FAO’s Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs.” Food and Agriculture Organization of the United Nations.

able to form swarms.<sup>98</sup> Existing national locust centers that historically have had reoccurring locust swarms would be the main actors responsible for maintaining the drones themselves and collecting their own data.<sup>99</sup>

The first test of dLocust was conducted in March of 2018 in Mauritania. It involved the FAO's Commission for Controlling the Desert Locust in the Western Region (CLCPRO), as well as the Desert Locust Information Service (DLIS), who conducted the test themselves.<sup>100</sup> Although the results collected were based on simulations, as they did not test the technology on an actual locust swarm, they were still used to continue to develop the technology over the next two years and to determine improvements that need to be made.<sup>101</sup> In order to ensure accessibility and widespread use of this technology, the drones would have to be "lightweight, portable, solar-powered, durable and easy to use and maintain locally"<sup>102</sup> For this reason, they are not yet able to be mass-produced, as the necessary technology has not yet advanced far enough.<sup>103</sup> In addition to technological limitations, other challenges surrounding the project include legal and sensitivity issues as well as determining the best strategies for spraying.<sup>104</sup> Many Member States in East Africa are still drafting laws surrounding the use of drones, with most prohibiting their use unless strict approval is given by the Member State.<sup>105</sup> Regarding spraying strategies, although small atomizer sprays already exist for drones, further tests must be done to determine the ideal speed, height, and range for drones to release their pesticides.<sup>106</sup> In so doing, their safety and effectiveness can be improved upon, so as to also avoid pesticide drift and operator contamination.<sup>107</sup> As of April 2020, the FAO is still prototyping both rotary and fixed-wing drones to be used in monitoring locust activities, particularly in Kenya.<sup>108</sup>

### **Conclusion**

The Food and Agriculture Organization has continued to play a key role in developing agricultural innovation, through initiatives such as FIES, dLocust, and increasing mechanization, particularly for smallholders and family farmers. However, for there to be success at a local level, more work is needed. Bringing advanced equipment that can easily measure and counteract potential agricultural threats to small communities has allowed for them to be more self-sustainable resilient against the changes that the world, as a whole, is facing. dLocust is an example of a more advanced solution that can help individuals and their governments, but even simpler solutions, such as sustainable mechanization, can create more opportunities for small farming communities and develop their economies. Even more so, developing technologies that can facilitate the exchange of knowledge can prove to be extremely helpful, especially when it comes to farmers diversifying their crops. The best forms of innovation are not those that require advanced and complicated methods to achieve their goals, but rather, those that are accessible and adaptable. Ultimately, through greater agricultural technology, the goal is for there to be greater food security and more sustainable farming methods that can help developing Member States and local communities become more self-sufficient.

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<sup>98</sup> "FAO's Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs." Food and Agriculture Organization of the United Nations.

<sup>99</sup> "FAO's Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs." Food and Agriculture Organization of the United Nations.

<sup>100</sup> "First test of dLocust in Mauritania (Mar 2018)." YouTube, <https://www.youtube.com/watch?v=zfEqTWkoSYM> (Accessed April 25, 2020).

<sup>101</sup> "First test of dLocust in Mauritania (Mar 2018)." YouTube.

<sup>102</sup> "FAO's Work on Agricultural Innovation: Sowing the seeds of transformation to achieve the SDGs." Food and Agriculture Organization of the United Nations.

<sup>103</sup> "First test of dLocust in Mauritania (Mar 2018)." YouTube.

<sup>104</sup> "Drones for locust early warning & preventive control." Food and Agriculture Organization of the United Nations, <http://www.fao.org/ag/locusts/en/activ/DLIS/drones/index.html> (Accessed May 30, 2020).

<sup>105</sup> "Smart drones to be tested in battle against East Africa locust swarms." Reuters, <https://www.reuters.com/article/us-kenya-locusts-tech/smart-drones-to-be-tested-in-battle-against-east-africa-locust-swarms-idUSKBN2041XZ> (Accessed May 30, 2020).

<sup>106</sup> "Smart drones to be tested in battle against East Africa locust swarms." Reuters.

<sup>107</sup> "Drones for locust early warning & preventive control." Food and Agriculture Organization of the United Nations.

<sup>108</sup> "In East Africa, a race to outsmart locusts with drones and data." Food and Agriculture Organization of the United Nations, <http://www.fao.org/fao-stories/article/en/c/1270472/> (Accessed August 6, 2020).

### ***Committee Directive***

New discoveries and technologies are being developed every day so it is important to take note of all the various sectors that can potentially play a role in creating new equipment and how that equipment can significantly benefit the lives of family farmers and smallholders. While conducting their research, delegates should consider the following: What are the regions, or particular Member States, most affected by food insecurity and what solutions are they calling for? What existing programs can be developed, or improved upon, to strengthen food security? What are key issues impacting family farmers and smallholders within your Member State today? What are potential sustainable solutions to these problems? What are the limitations of potential solutions to food insecurity? How accessible will the technology be to Member States when it is fully developed?

## II. Addressing Climate Change's Impact on the Agriculture Industry

### *Introduction*

Climate change, which is globally recognized as, “a long-term change in average weather patterns that have come to define Earth’s local, regional and global climates,”<sup>109</sup> has resulted in more frequent droughts and heat waves, rising temperatures, strengthened hurricanes and monsoons, sea-level rise, and changes in precipitation patterns across the globe.<sup>110</sup> These effects of climate change have been tied to the increase in global hunger rates and levels of food insecurity.<sup>111</sup> Food insecurity has been defined as a “situation when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active healthy life,” and severe food insecurity means that there is, “an insufficient quantity of food,” thus resulting in undernourishment and hunger within a population.<sup>112</sup>

In 2018, in conjunction with several United Nations (UN) agencies, the Food and Agriculture Organization (FAO) released its 2018 report on the state of food security and nutrition in the world.<sup>113</sup> The report called attention to new evidence that suggests a previous decline in global hunger rates had ceased, with a now estimated 821 million people categorized as undernourished in 2017, as compared to 783.7 million in 2014.<sup>114</sup> The FAO further stated that, in accordance with the Food Insecurity Experience Scale (FIES), approximately 770 million individuals globally are experiencing severe food insecurity.<sup>115</sup> The recent increase in global hunger rates has been found to have been caused by two on-going trends: persistent droughts attributed to climate change and on-going conflicts.<sup>116</sup>

With the occurrence of both droughts and wetter growing seasons becoming more frequent, many farmers are without the proper tools for water management for their crops and livestock meaning they are facing an increased risk to their livelihoods.<sup>117</sup> Several sectors of agriculture are dependent on a stable, suitable climate for optimum productivity and output.<sup>118</sup> However, climate change has created an obstacle to efficient agribusiness as farmers now face changes in carbon dioxide (CO<sub>2</sub>) levels, temperature, and precipitation.<sup>119</sup>

The effects of climate change can vary vastly from region to region. In June of 2017, the drought in East Africa, contributed to wide spread food insecurity within the region as farmers faced poor harvests of grain and seed stock, in conjunction with low milk and meat production from livestock.<sup>120 121</sup> Conversely, Peru experienced extreme

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<sup>109</sup> “Overview: Weather, Global Warming and Climate Change.” NASA, <https://climate.nasa.gov/resources/global-warming-vs-climate-change/> (Accessed May 19, 2020)

<sup>110</sup> “The Effects of Climate Change.” NASA, <https://climate.nasa.gov/effects> (Accessed May 19, 2020)

<sup>111</sup> “Attributing extreme weather to climate change.” Carbon Brief, <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world> (Accessed May 19, 2020)

<sup>112</sup> “Hunger and Undernourishment.” Our World in Data, <https://ourworldindata.org/hunger-and-undernourishment> (Accessed June 19, 2020)

<sup>113</sup> “2018 The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition. The food and Agriculture Organization of the United Nations, <http://www.fao.org/3/I9553EN/i9553en.pdf> (Accessed June 19, 2020)

<sup>114</sup> “2018 The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition”. The food and Agriculture Organization of the United Nations.

<sup>115</sup> “2018 The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition”. The food and Agriculture Organization of the United Nations.

<sup>116</sup> “2018 Global Report on Food Crises shows rising food insecurity, need to build resilience.” International Food Policy Research Institute, <https://www.ifpri.org/blog/2018-global-report-food-crises-shows-rising-food-insecurity-need-build-resilience> (Accessed May, 19 2020)

<sup>117</sup> “Climate change, water and food security.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/i2096e/i2096e.pdf> (Accessed May 20, 2020)

<sup>118</sup> “Climate Impacts on Agriculture and Food Supply.” United States Environmental Protection Agency, [https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply\\_.html](https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply_.html) (Accessed May 20, 2020)

<sup>119</sup> “Climate Impacts on Agriculture and Food Supply.” United States Environmental Protection Agency.

<sup>120</sup> “Attributing extreme weather to climate change.” Carbon Brief, <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world> (Accessed May 19, 2020)

<sup>121</sup> “With Continued drought, Horn of Africa braces for another hunger season.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/news/story/en/item/460996/icode/> (Accessed May 20, 2020)

rainfall in March of 2017, as a result of warming ocean waters.<sup>122</sup> According to the FAO, this increase in rainfall meant that approximately 7,000 Peruvian farmers experienced reduced agricultural productivity causing decreasing crop yields in nine of its harvested crops: coffee, beans, yellow corn, starchy corn, rice, onion, tomato, banana and, rice.<sup>123</sup>

The FAO has and will continue to offer technical expertise, community development, and knowledge sharing, as a way to aid in Member States agricultural adaptations to climate change.<sup>124</sup> Additionally, climate financing and agricultural investments have been proven to be critical for a global transformation to sustainable agricultural practices.<sup>125</sup> These investments allow the roughly 80 percent of the world's poor smallholders living in rural areas access to financing that will allow them to develop climate-resistant agricultural processes within all major sectors of agriculture.<sup>126</sup>

### ***Previous Actions of the FAO***

The Food and Agricultural Organization (FAO) has been actively focused on supporting Member States that have been affected by climate change since 2009.<sup>127</sup> In 2002, following the World Summit on Sustainable Development (WSSD), the FAO established the framework for Globally Important Agricultural Heritage Systems (GIAHS).<sup>128</sup> A GIAHS designation by the FAO means that said agricultural site is recognized to be an, “outstanding symbiosis between man and nature, which produces an enduring production and social system that is adaptable and dynamic.”<sup>129</sup> There are currently 59 designated sites in 22 Member States, spanning the globe.<sup>130</sup> The objective of GIAHS was to, “identify and safeguard Globally Important Agricultural Heritage Systems and their associated landscapes, agricultural biodiversity, knowledge systems and culture.”<sup>131</sup> These traditional agricultural systems represent models of sustainable agricultural production.<sup>132</sup> Four GIAHS sites were featured in FAO's Climate-Smart Agriculture sourcebook: rice-fish agriculture systems in China; sustainable practices of nomadic pastoralists in Iran, Peruvian Andes and Kuttanad below-sea-level farming system.<sup>133</sup>

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<sup>122</sup> “Attributing extreme weather to climate change.” Carbon Brief, <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world> (Accessed May 19, 2020)

<sup>123</sup> “Supporting farmers in Peru recover from El Nino floods and landslides.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/news/story/en/item/887462/icode/> (Accessed May 20, 2020)

<sup>124</sup> “FAO's Work on Climate Change: 2018.” Food and Agriculture Organization of the United Nations, <https://reliefweb.int/sites/reliefweb.int/files/resources/FAO%E2%80%99s%20Work%20on%20Climate%20Change.pdf> (Accessed July 16, 2020)

<sup>125</sup> “Making Climate Finance Work in Agriculture.” The World Bank, <https://www.worldbank.org/en/topic/agriculture/publication/making-climate-finance-work-in-agriculture> (Accessed June 29, 2020)

<sup>126</sup> “FAO's Work on Climate Change: 2016.” Food and Agriculture Organization of the United Nations, [www.fao.org/3/a-i6273e.pdf](http://www.fao.org/3/a-i6273e.pdf) (Accessed May 21, 2020)

<sup>127</sup> “Climate Change.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/climate-change/en/>. (Accessed March 26, 2020.)

<sup>128</sup> “Globally important agricultural heritage systems (giahs) of china: the challenge of complexity in research.” Ecological Society of America, <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/EHS14-0007.1> (Accessed May 23, 2020)

<sup>129</sup> “Globally important agricultural heritage systems (giahs) of china: the challenge of complexity in research.” Ecological Society of America.

<sup>130</sup> “Designated Sites Around the World.” Food and Agriculture Organization on the United Nations, <http://www.fao.org/giahs/giahsaroundtheworld/designated-sites/en/> (Accessed July 1, 2020)

<sup>131</sup> “GIAHS: Globally Important Agricultural Heritage Systems.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/giahs/background/goal-and-objectives/en/> (Accessed May 23, 2020)

<sup>132</sup> “GIAHS: Globally Important Agricultural Heritage Systems.” Food and Agriculture Organization of the United Nations.

<sup>133</sup> “What is Climate Smart Agriculture?” Research Program on Climate Change, Agriculture and Food Security, <https://csa.guide/csa/what-is-climate-smart-agriculture> (Accessed May 24, 2020)

Starting in 2010, the FAO began implementing Climate-Smart Agriculture (CSA).<sup>134</sup> CSA includes, “agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes Green House Gases (GHGs) (mitigation) where possible, and enhances achievement of national food security and development goals.”<sup>135</sup> An example of this program is the Drought-Tolerant Maize for Africa (DTMA).<sup>136</sup> Maize, a variety of corn, is grown widely in Sub-Saharan Africa (SSA) and considered a staple crop for the majority of Member States within the region.<sup>137</sup> With average daily temperatures rising and average rainfall falling, many Member States in SSA are experiencing a decrease in maize yields.<sup>138</sup> In response, DTMA, in collaboration with 13 Member States across Africa, worked to develop 200 varieties of drought-tolerant maize.<sup>139</sup> It was estimated that by 2014, the DTMA project had impacted 5.2 million households across SSA by producing a sufficient yield for the SSA population.<sup>140</sup>

### **Current Projects and Programs**

In 2017, Climate Change Adaptation in the Eastern Caribbean Fisheries Sector Project (CC4FISH), was implemented in response to climate change causing sargassum influxes, coral reef bleaching, damaged infrastructures, and hurricanes in the Eastern Caribbean Region.<sup>141</sup> The objective of the project, which will run from January 2017 through December 2020, is to assist in expanding the versatility of fishing methods and to diminish impacts of climate change on Eastern Caribbean fishers.<sup>142</sup> CC4FISH will impact seven Member States: Antigua and Barbuda, Saint Kitts and Nevis, Dominica, Saint Lucia, Saint Vincent and the Grenadines, Grenada and, Trinidad and Tobago. <sup>143</sup> As of February 2020, CC4Fish had successfully supported the development of aquaculture by conducting aquaponics workshops and providing tailored aquaculture strategies for the individual Member States.<sup>144</sup> They have also established new aquaponics farms in St. Kitt and Nevis, as well as implemented Fisheries and Aquaculture Emergency Response (FARE) training to help mitigate the risk to aquaculture due to natural disasters.<sup>145</sup>

It is known that climate change effects global weather patterns, increases the frequency of natural disasters, and can strain agricultural production.<sup>146</sup> In 2018, it was estimated by the United States Geological Surveys (USGS), and the Intergovernmental Panel on Climate Change (IPCC) that by the year 2020, the continent of Africa could see up to a 50 percent decrease in crop-yields from rain-fed crops due to more frequent droughts.<sup>147</sup> In March of 2020, the FAO released its quarterly global report, *Crop Prospects and Food Situation*.<sup>148</sup> This report stated that as of the first

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<sup>134</sup> “FAO Success Stories on Climate-Smart Agriculture.” Food and Agriculture Organization of the United Nations, [www.fao.org/3/ai3817e.pdf#:~:text=Climatesmart%20agriculture%20%28CSA%29%2C%20as%20defined%20and%20presented%20by,agricultural%20development%20for%20food%20security%20under%20climate%20change](http://www.fao.org/3/ai3817e.pdf#:~:text=Climatesmart%20agriculture%20%28CSA%29%2C%20as%20defined%20and%20presented%20by,agricultural%20development%20for%20food%20security%20under%20climate%20change). (Accessed May 29, 2020)

<sup>135</sup> “What is Climate Smart Agriculture?” Research Program on Climate Change, Agriculture and Food Security, <https://csa.guide/csa/what-is-climate-smart-agriculture> (Accessed May 24, 2020)

<sup>136</sup> “A New Generation of Maize for Africa.” International Maize and Wheat Improvement Center, [http://dtma.cimmyt.org/index.php/publications/doc\\_view/196-a-new-generation-of-maize-for-africa](http://dtma.cimmyt.org/index.php/publications/doc_view/196-a-new-generation-of-maize-for-africa) (Accessed May 27, 2020)

<sup>137</sup> “Climate Change Impacts on Sustainable Maize Production in Sub-Saharan Africa: A Review.” InTech Open, <https://www.intechopen.com/books/maize-production-and-use/climate-change-impacts-on-sustainable-maize-production-in-sub-saharan-africa-a-review> (Accessed May 24, 2020)

<sup>138</sup> “Climate Change Impacts on Sustainable Maize Production in Sub-Saharan Africa: A Review.” InTech Open.

<sup>139</sup> “A New Generation of Maize for Africa.” International Maize and Wheat Improvement Center.

<sup>140</sup> “A New Generation of Maize for Africa.” International Maize and Wheat Improvement Center.

<sup>141</sup> “Climate Change Adaptation of the Eastern Caribbean Fisheries Sector.” ClimeFish, [https://climefish.eu/wp-content/uploads/sites/18/2020/03/5f.Parallel Session - Marine Fisheries - Eastern Caribbean - FAO - Climefish Forum 2020 Eastern Caribbean I.Monnerreau.pdf](https://climefish.eu/wp-content/uploads/sites/18/2020/03/5f.Parallel%20Session%20-%20Marine%20Fisheries%20-%20Eastern%20Caribbean%20-%20FAO%20-%20Climefish%20Forum%202020%20Eastern%20Caribbean%20I.Monnerreau.pdf) (Accessed May 30, 2020)

<sup>142</sup> “Climate Change Adaptation of the Eastern Caribbean Fisheries Sector.” ClimeFish.

<sup>143</sup> “Climate Change Adaptation of the Eastern Caribbean Fisheries Sector.” ClimeFish.

<sup>144</sup> “Climate Change Adaptation of the Eastern Caribbean Fisheries Sector.” ClimeFish.

<sup>145</sup> “Climate Change Adaptation of the Eastern Caribbean Fisheries Sector.” ClimeFish.

<sup>146</sup> “What are the long-term effects of climate change.” United States Geological Surveys, [https://www.usgs.gov/faqs/what-are-long-term-effects-climate-change-1?qt-news\\_science\\_products=3#qt-news\\_science\\_products](https://www.usgs.gov/faqs/what-are-long-term-effects-climate-change-1?qt-news_science_products=3#qt-news_science_products) (Accessed May 20, 2020)

<sup>147</sup> “What are the long-term effects of climate change.” United States Geological Surveys

<sup>148</sup> “Crop Prospects and Food Situation.” Food and Agriculture Organization of the United Nations. [fao.org/3/ca8032en/ca8032en.pdf](http://fao.org/3/ca8032en/ca8032en.pdf) (Accessed July 3, 2020)

quarter of 2020, regional droughts continued to have a negative effect on crop prospects across the continent.<sup>149</sup> While not as severe of a decline as anticipated in 2018, the continent saw a decrease in grain or cereal production in the amount of 4.6 million tons of grain, with the majority of losses concentrated in the regions of North Africa, East Africa and South Africa.<sup>150</sup> This loss differential could be attributed to the FAOs response to the growing crisis across the continent in 2017, when the FAO enacted the Early Warning Early Action (EWEA) system across the continent.<sup>151</sup> The EWEA system, provides two different response plans, global EWEA, and Member State level EWEA. Global level EWEA uses analysis, advocacy and partnership strategies to monitor risks to agricultural production, and food security.<sup>152</sup> Corresponding Member State level EWEA consists of early actions that are representative to crises that the region is most susceptible to and occur after an early warning sign but before the occurrence of a disaster.<sup>153</sup> The primary objective of EWEA is to mitigate the impact of disasters before they happen,<sup>154</sup> while also providing quarterly reports on the status of food security and agriculture, in the face of global climate change risk factors.<sup>155</sup>

The EWEA report summary released in May of 2020 called specific attention to the lack of rain fall in Burkina Faso, Mali, and Niger.<sup>156</sup> The previous summary anticipated that 2 million individuals within the region would become food insecure as a result of COVID-19.<sup>157</sup> However, with the addition of the lack of rainfall, they now project this number to reach 2.7 million.<sup>158</sup> The pandemic, in addition to the 12 percent drop in grain production resulting from rainfall shortages, has created an inadequate supply of livestock feeds.<sup>159</sup> Through the EWEA system, the FAO will provide individuals in the regions with 4,500 tons of livestock feed to support livestock smallholders no later than July of 2020.<sup>160</sup> Additionally, there is a planned long-term response, designed to further support EWEA in Niger.<sup>161</sup>

### **Case Study**

#### *Coastal Fisheries in the United Republic of Tanzania*

Fisheries can be defined as systematic labor by individuals or corporations to catch fish.<sup>162</sup> Fisheries are commonly known for not only providing communities with food, but also acquiring fish products such as fish oils.<sup>163</sup> This agricultural sector is essential for the Tanzanian community as they rely on offshore fisheries for a significant amount of their food supply.<sup>164</sup> An estimated 70 percent of Tanzanians live in rural areas forcing them to solely depend on either farming or fisheries in order to provide food to the their community.<sup>165</sup> Additionally, in 2016, the

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<sup>149</sup> “Crop Prospects and Food Situation.” Food and Agriculture Organization of the United Nations.

<sup>150</sup> “Crop Prospects and Food Situation.” Food and Agriculture Organization of the United Nations.

<sup>151</sup> “Impact of Early Warning Early Action.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/ca0227en/CA0227EN.pdf> (Accessed July 10, 2020)

<sup>152</sup> “Early Warning Early Action.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/emergencies/fao-in-action/ewea/en/> (Accessed May 30, 2020)

<sup>153</sup> “Early Warning Early Action.” Food and Agriculture Organization of the United Nations.

<sup>154</sup> “Early Warning – Early Action (EWEA) – FAO is developing a new tool that helps attenuate the impact of disasters before they occur.” United Nations Convention to Combat Desertification, <https://knowledge.unccd.int/publications/early-warning-early-action-ewea-fao-developing-new-tool-helps-attenuate-impact> (Accessed May 29, 2020)

<sup>155</sup> “Early Warning- Early Action (EWEA) System.” Food Security Portal, <http://www.foodsecurityportal.org/early-warning-system/clone-backup-other-food-security-resources> (Accessed May 30, 2020)

<sup>156</sup> “The Niger Response Overview” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/ca9352en/ca9352en.pdf> (Accessed May 30, 2020)

<sup>157</sup> “The Niger Response Overview.” Food and Agriculture Organization of the United Nations.

<sup>158</sup> “The Niger Response Overview.” Food and Agriculture Organization of the United Nations.

<sup>159</sup> “The Niger Response Overview.” Food and Agriculture Organization of the United Nations.

<sup>160</sup> “The Niger Response Overview.” Food and Agriculture Organization of the United Nations.

<sup>161</sup> “The Niger Response Overview.” Food and Agriculture Organization of the United Nations.

<sup>162</sup> “Fishery.” Science Daily, <https://www.sciencedaily.com/terms/fishery.htm> (Accessed May 25, 2020).

<sup>163</sup> “Fishery.” Science Daily.

<sup>164</sup> “Case studies on climate change and Africa coastal Fisheries: A vulnerability analysis and recommendations for adaptations options.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/a-i5612e.pdf> (Accessed My 24, 2020)

<sup>165</sup> “Case studies on climate change and Africa coastal Fisheries: A vulnerability analysis and recommendations for adaptations options.” Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/a-i5612e.pdf> (Accessed My 24, 2020)

Tanzanian economy saw a profit of USD \$188 Million from fishery product exports alone.<sup>166</sup> Climate change may potentially impact services and products that oceanic ecosystems have provided such as fish and fish products.<sup>167</sup> As a consequence, the maximum catch potential, or the maximum exploitable catch of a species, in Tanzania is estimated to decrease by thirty percent by the beginning of 2050.<sup>168</sup>

This estimated decrease in maximum catch potential may lead to socioeconomic vulnerability, in addition to the negative impacts on Tanzania food security.<sup>169</sup> However, utilizing catch rates as a sustainability indicator has become a significant risk due to concerns regarding the reliability of this approach. Scientists are required to calculate fish stocks population size.<sup>170</sup> They do this by using the virtual population analysis (VPA) method.<sup>171</sup> The VPA method is used as an accounting approach that acquires estimated natural mortality that affects the stock size of fish.<sup>172</sup> In addition, fish stocks also have a minimum landing size.<sup>173</sup> Fish that are captured and are less than the required size are returned to sea.<sup>174</sup> As a result, this restriction limits the amount of fish that can be provided to the Tanzania population.<sup>175</sup>

The Government of Tanzania's response to the need for fishery management has been to plan and execute the Tanzanian Artisanal Fishery Management System for small and medium pelagic species.<sup>176</sup> The characteristics of small pelagic species require adaptable and flexible fishery management techniques.<sup>177</sup> Fisheries have begun focusing on allowing the adaptation of conditions that are constantly changing in order to prepare small-scale fishery stakeholders to endure environmental and economic disruptions such as the imbalance on the oceans acidity levels.<sup>178</sup> The obstacle the Tanzanian government is currently faced with has been to discover the most effective method of taking control of how to accurately define ecologically sustainable levels, which requires expensive research vessels and appropriate technical capacities.<sup>179</sup> The Tanzanian administrators and officials are required to enforce the industry's effort restrictions and affiliate themselves with partners such as the African Development (NEPAD)–FAO Fish Programme (NFFP) that would agree to those restrictions.<sup>180</sup> The current fishery proposal

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- <sup>166</sup>“The Tanzanian Fisheries Sector: Challenges and Opportunities.” United Republic of Tanzania Ministry of Agriculture, Livestock and fisheries, <https://tanzania.um.dk/~media/tanzania/documents/business%20sector/the%20tanzanian%20fisheries%20sector%20-%20challenges%20and%20opportunities.pdf?la=en> (Accessed July 12, 2020)
- <sup>167</sup> Cheung, Willam L., Lam, Vicky W., Sarmiento, Jorge L., Kearney, Kelly and, Pauly, Daniel. “Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change.” *Global Change Biology*. 16, 25-35. Blackwell Publishing Ltd, 2009.
- <sup>168</sup> “Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change.” *Global Change Biology*, <https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2486.2009.01995.x#:~:text=We%20show%20that%20climate%20change.to%2040%25%20in%20the%20tropics.&text=Thus%2C%20our%20results%20indicate%20the,climate%20change%20impacts%20through%20fisheries.> (Accessed June 11, 2020)
- <sup>169</sup> “Large-scale redistribution of maximum fisheries catch potential in Elemnta the global ocean under climate change.” *Global Change Biology*.
- <sup>170</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene, <https://www.elementascience.org/articles/10.1525/elementa.346/#:~:text=The%20concept%20of%20sustainable%20fishing,economic%20exploitation%20of%20a%20system.> (Accessed June 11, 2020)
- <sup>171</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene.
- <sup>172</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene.
- <sup>173</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene.
- <sup>174</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene.
- <sup>175</sup> “Sustainability: a flawed concept for fisheries management?” Elements Science of the Anthropocene.
- <sup>176</sup> “Case studies on climate change and Africa coastal Fisheries: A vulnerability analysis and recommendations for adaptations options.” Food and Agriculture Organization of the United Nations
- <sup>177</sup> “Case studies on climate change and Africa coastal Fisheries: A vulnerability analysis and recommendations for adaptations options.” Food and Agriculture Organization of the United Nations
- <sup>178</sup> “Managing Small-Scale Commercial Fisheries for Adaptive Capacity: Insights from Dynamic Social-Ecological Drivers of Change in Monterey Bay.” PLoS ONE, <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118992> (Accessed June 1, 2020)
- <sup>179</sup> Case studies on climate change and Africa Coastal Fisheries: A Vulnerability Analysis and Recommendations for Adaptations Options Food and Agriculture Organization of the United Nations, <http://www.fao.org/3/a-i5612e.pdf> (Accessed My 24, 2020)
- <sup>180</sup> “Case studies on climate change and Africa Coastal Fisheries: A Vulnerability Analysis and Recommendations for Adaptations Options Food and Agriculture Organization of the United Nations.



recommends licensing for small-scale fishermen through the Central Coordinating Committees (CCCs) that administer the Collaborative Fishery Management Areas (CFMAs), through local authorities, and by the Semi-Industrial Fisheries Ministry.<sup>181</sup> This would require regular (e.g. annual/biannual) updates of biomass (the total mass of organisms in a given area or volume) predictions to limit fishing mortality.<sup>182</sup> For example, restricting fisheries from participating in previous practices such as killing fish that don't meet fisheries qualifications, as opposed to returning them to their ecosystem, in addition to setting quotas or total allowable catches (TACs).<sup>183</sup>

## ***Conclusion***

In 2018, the report on the state of food security and nutrition in the world, in cooperation with the World Health Organization, the Food and Agriculture Organization, recognized a change in global hunger and nutrition rates.<sup>184</sup> While the FAO had previously seen a decline from 2014 to 2017 in global hunger rates, there was an increase from 783.7 million people to 821 million globally from 2017 to 2018.<sup>185</sup> The FAO, having acknowledged that increase was a result of the greater effects on climate change, has fought to ensure that Member States and their respective agricultural practices remain sustainable.

Although climate change may not be avoidable, the international community, with the help of Member States, may be able to control the outcome of the effects of climate change and its impact on agricultural industries globally. As a result of environmental changes such as droughts across Africa, heavier rainfall in Peru and increased acidity in the Indian Ocean, many farmers without the proper tools for water management, livestock, crops, fisheries have all face increased risk to their livelihoods, and food security due to decreased agricultural productivity, profit and sustainability. The FAO has strived to mitigate the risks these smallholders face through the implementations of ongoing initiatives, such as GIAHS, CSA, DTMA, and EWEA. Each initiative, although unique, aims to aid Member States with sustainability practices in each sector, conservation of unique agricultural systems, and risk management in the face of new environmental changes due to climate change. The FAO has and will continue to offer technical expertise, community development, and knowledge sharing, to aid in Member States agricultural adaptations to climate change.<sup>186</sup>

## ***Committee Directive***

FAO delegates are expected to be well informed on the topic of climate change in addition familiarizing themselves with the effects of climate change on their specific Member State. Delegates' focus should be on questions such as: What agricultural industries are most vulnerable as a result of climate change? What are currently the greatest risks to smallholders, otherwise known as small family famers, and agricultural stake holders, within each Member State? How are smallholders within Member States adapting to climate change? What current policies exist within your Member State to aid against the impacts of Climate Change? What policies would be beneficial in negating the effects of climate change on smallholders, and agribusiness as a whole?

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<sup>181</sup> "Case studies on climate change and Africa coastal Fisheries: A Vulnerability Analysis and Recommendations for Adaptations Options." Food and Agriculture Organization of the United Nations.

<sup>182</sup> "Biomass." Lexico, <https://www.lexico.com/en/definition/biomass> (Accessed June 2, 2020)

<sup>183</sup> Case studies on climate change and Africa coastal Fisheries: A Vulnerability Analysis and Recommendations for Adaptations Options." Food and Agriculture Organization of the United Nations.

<sup>184</sup> "2018 The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition. The food and Agriculture Organization of the United Nations, <http://www.fao.org/3/19553EN/i9553en.pdf> (Accessed June 19, 2020)

<sup>185</sup> "2018 The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition". The food and Agriculture Organization of the United Nations.

<sup>186</sup> "FAO's Work on Climate Change: 2018." Food and Agriculture Organization of the United Nations, <https://reliefweb.int/sites/reliefweb.int/files/resources/FAO%E2%80%99s%20Work%20on%20Climate%20Change.pdf> (Accessed July 16, 2020)

## Annotated Bibliography

### Topic I: Utilizing Technology to Eliminate Food Insecurity

Kumar, Deepak, and Prasanta Kalita. "Reducing Postharvest Losses during Storage of Grain Crops to Strengthen Food Security in Developing Countries." *Foods* 6, no. 8 (2017): 1-22. <https://www.mdpi.com/2304-8158/6/1/8>.

This detailed review explains what postharvest loss is and how it impacts the global economy and food security. Specific attention is given to the loss of cereal grains in developing Member States. After providing an in-depth description of the grain supply chain process from harvesting to milling, it then provides specific details about the postharvest losses of rice, wheat, and maize in different developing Member States across the globe. Factors that influence postharvest loss include insect and rodent infestations, fungi contamination, temperature, humidity, and rain. Proposed technological improvements to combat these factors include chemical fumigation, natural insecticides, and airtight (hermetic) storage.

Little, David C., and Stuart W. Bunting. "Aquaculture Technologies for Food Security." In *Emerging Technologies for Promoting Food Security: Overcoming the World Food Crisis*, 93-113. Woodhead Publishing, 2016. <https://www.sciencedirect.com/science/article/pii/B9781782423355000056?via%3Dihub>.

This article provides an overview of the ways aquaculture technologies can be used to combat food insecurity for low and middle-income societies that rely on fish as a key part of their diet. It explains what pressures aquaculture farmers face that have led to poor results from aquaculture farming in the past and provides instructions on what steps need to be taken in the future to avoid these results. Recommendations include (1) improving technology designs used to recirculate and remove solids from water, thereby improving overall water quality, (2) not over-stocking and over-feeding fisheries, (3) imposing zoning limits to prevent larger producers from pushing out small farmers, (4) breeding more robust animals, including juvenile fish, to better meet consumer demands, and (5) improving record keeping and traceability systems.

Ncube, Bongani, Walter Mupangwa, and Adam French. "Precision Agriculture and Food Security in Africa." In *Systems Analysis Approach for Complex Global Challenges*, 159-178. Springer International Publishing, 2018. [https://www.researchgate.net/publication/324372637\\_Precision\\_Agriculture\\_and\\_Food\\_Security\\_in\\_Africa](https://www.researchgate.net/publication/324372637_Precision_Agriculture_and_Food_Security_in_Africa).

This paper provides a comprehensive overview of precision agriculture: what it is, various areas of focus included under it, the technologies it uses, and the ways it can help farmers achieve maximum efficiency and higher profit margins. Specific areas of focus include precision agriculture's effects on costs of production, the environment, and crop yields. It has shown to especially increase crop yields for corn, rice, wheat, and pulse, key foods used to combat food insecurity. This article also shares two case studies conducted in South Africa, Mozambique, Tanzania and Zimbabwe that demonstrate the tangible positive effects precision agriculture can have for both commercial and small-scale farmers.

Omotilewa, Oluwatoba, Jacob Ricker-Gilbert, John Herbert Ainembabazi, and Gerald Shively. "Does Improved Storage Technology Promote Modern Input Use and Food Security? Evidence from a Randomized Trial in Uganda." *Journal of Development Economics* 135 (2018): 176-198. <https://www.sciencedirect.com/science/article/pii/S030438781830926X?via%3Dihub>.

This article investigates whether providing Ugandan farmers with improved food storage technology affects the crops they choose to grow for the season, seeing as it could allow them to grow crops that traditionally have higher yields but shorter shelf lives. The study found that applying the advanced storage methods made farmers more likely to plant improved maize hybrids, store maize longer, and forego chemical pesticides. This study can help combat food insecurity by providing information related to technology necessary to increase productivity of stronger maize breeds.

Wani, Suhas P., Mukund D. Patil, and Dhirendra Singh. "Strengthening Food Security Through Technologies." *National Security* 2, no. 2 (2019): 170-190.  
[https://www.researchgate.net/publication/335946167\\_Strengthening\\_Food\\_Security\\_through\\_Technologies](https://www.researchgate.net/publication/335946167_Strengthening_Food_Security_through_Technologies).

This recent article includes a brief description of the three measures of food security – affordability, quality and safety, and availability – and details how these relate specifically to India, which is ranked 76th in global food security. It also discusses potential technological innovations that could increase food security, including: (1) crop improvements, like genetic modifications, (2) using large-scale data to better manage natural resources and alleviate or avoid risks associated with climate, market, and production systems, (3) creating and providing accessibility to advanced market and trade networks, and (4) improving communication tools to strengthen agriculture extension systems.

Krehbiel, Clint. "The role of new technologies in global food security: Improving animal production efficiency and minimizing impacts." *Department of Animal Science, Oklahoma State University*.(2013): 1-7.  
<https://academic.oup.com/af/article-pdf/3/3/4/32410045/4.pdf>

This detailed document examines the state of undernourishment within the international population, and the need to address the growing issue of food security on a global scale. With the suggestion that the demand for animal protein is expected to double by the year 2015, the document lays out recommendations to increase production within the beef industry. It identifies the potential for the use of growth technologies, including animal biotechnologies such as steroidal impacts and reproductive cloning with the goal of utilizing each to assist in both increasing livestock production as well as to ensure the viability of animal proteins for consumption.

## **Topic II: Addressing Climate Change's Impact on the Agriculture Industry**

Ali, Sajjad, Ying Liu, Muhammad Ishaq, Tariq Shah, Abdullah, Aasir Ilyas, and Izhar Ud Din. "Climate Change and Its Impact on the Yield of Major Food Crops: Evidence from Pakistan." *Foods* 6, no. 39 (2017): 1-19.  
<https://www.mdpi.com/2304-8158/6/6/39/htm>

This study provides an overview of the way climate change impacts farmers in developing Member States, specifically in the regions of Africa and South Asia. It details the environmental and economic impacts of climate change on the agriculture industry and goes in-depth into the specific challenges Pakistan is facing. Using data gathered from 1989-2015, it analyzes the impact of climate change variables, specifically temperature, rainfall humidity and sunshine, on the yield of major food and cash crops grown in Pakistan during that time period. The study also identifies several factors, such as availability of water per capita, and drought that have had the greatest impact on Pakistan's agriculture industry. This information can help prove the reality of climate change's negative impact on Pakistan's agriculture industry and spur governments to take action to address this problem.

Asrat, Paulos, and Belay Simane. "Farmers' Perception of Climate Change and Adaptation Strategies in the Dabus Watershed, North-West Ethiopia." *Ecological Processes* 7, no. 7 (2018): 1-13.  
<https://ecologicalprocesses.springeropen.com/articles/10.1186/s13717-018-0118-8>.

This article explores how Ethiopian farmers perceive and understand climate change and how that can influence their adaptive responses to climate change. Primary and secondary data was collected and analyzed to inform the article's key findings: environmental, socio-economic, and institutional factors all have an impact on a farmer's perception of and adaptation to climate change. The gender of the household head also has an impact on farmers' adaptive decisions. Many of the challenges facing farmers' ability to respond proactively to climate change are connected to the institutions, infrastructure, and technologies they have access to. Strategies such as utilizing an extension service, providing training, and disseminating climate information could be successful at helping farmers in developing regions adopt strategies to combat climate change's negative impact on the agriculture industry.

Mehedi, Muhammad, Masud Mohammad, Nurul Azam, Muhammad Mohiuddin, Hasanul Banna, Rulia Akhtar, A.S.A. Ferdous Alam, and Halima Begum. "Adaptation Barriers and Strategies Towards Climate Change: Challenges in the Agricultural Sector." *Journal of Cleaner Production* 156 (2017): 698-706.  
<https://doi.org/10.1016/j.jclepro.2017.04.060>.

This detailed paper describes how climate change can adversely impact the agriculture sector, especially for small-scale farms. Its geographic region of focus is Malaysia, where most farmers lack the capacity to adapt to climate change due to adaptation barriers that include the farms income, a farmer's experience, limited access to agricultural markets, and limited access to agriculture extensions. By distributing 450 surveys to Malaysian farmers, this study identifies barriers that prevent farmers from adapting to climate change. Key findings reveal farm experience, education, and income level have the greatest effect on whether or not farmers will adopt adaptive practices. Increasing extension services, skills training, and access to weather forecasting systems could help improve farmers' ability to adapt.

Rojas-Downing, Melissa, Pouyan Nejadhashemi, Timothy Harrigan, and Sean A. Woznicki. "Climate Change and Livestock: Impacts, Adaptation, and Mitigation." *Climate Risk Management* 16 (2017): 145-163.  
<https://www.sciencedirect.com/science/article/pii/S221209631730027X?via%3Dihub>.

This article provides information related to the role livestock play both in the agriculture industry and global food security. It also offers an overview of climate change and its impact on the agriculture industry at-large. Its main content focuses on three general areas: (1) the impacts of climate change on livestock production, (2) the impacts of livestock production on climate change, and (3) potential strategies that can be used to adapt to and mitigate climate change. Key areas of study include livestock feed types, water access and usage, livestock diseases, the effects of heat stress, challenges related to land usage, and greenhouse gas emissions' role in climate change. This article offers several strategies that could be used to help crops and livestock better adapt to climate change and help mitigate livestock's negative impact on climate change.

Karimi, Vahid, Ezatollah Karami, and Marzieh Keshavarz. "Climate Change and Agriculture: Impacts and Adaptive Responses in Iran." *Journal of Integrative Agriculture* 17, no. 1 (2018): 1-15.  
<https://www.sciencedirect.com/science/article/pii/S2095311917617945>

This academic journal focuses on the impact climate change has on the Iranian agriculture sector, specifically related to its access to water, which is already a scarce resource. Background information about Iran is provided – its geographic location and topography, size, and climate – and statistical modelling is used to predict the future negative impacts of climate change on Iran's agriculture sector. The article concludes with recommendations for what can be done to overcome impending changes. Strategies include improving crop insurance and drought relief programs, encouraging farmers to diversify their income sources, and strengthening research, use of technology, and dissemination of information through an extension system.

Khan, M.A., and Tahir, A. "Economic Effects of Climate Change on Agriculture Productivity by 2035: A Case Study of Pakistan" *36<sup>th</sup> International Conference of Agricultural Economists*, (2018): 1-20.  
<https://ideas.repec.org/p/ags/iaae18/275969.html>

This document focuses on the economic impacts of climate change on Pakistan's agriculture industry. Providing a detailed explanation of the climate distributions of Pakistan, the document then goes on to explain Pakistan's ranking on the list of most vulnerable nations resulting from assessments of geographical and climatic features as noted on the global climate risk index. Continuing with an evaluation of the agricultures sectors production of both wheat and rice, each are recognized as key staple foods and cash crops within Pakistan. Then further explaining the economic effects of reduced production of both crops. The document concludes by offering an analysis of yield decline resulting from the constraints of climate change and the resulting increase in market price of both crops.