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The purpose of the study was to determine the topics and courses of a graduate certificate focusing on Global Food Security (GFS) for Latin America and the Caribbean (LAC) through critical action inquiry. GFS is a major issue worldwide that will continue to expand in years to come. Almost 795 million people are estimated to have suffered from chronic hunger globally in 2014-2016. Studies have shown the strong relationship between education and food security and we do not argue for causation, merely association. For this reason, curricula focused on teaching GFS to graduate students will enable professionals in international settings to manage the complexities of food security more effectively. For this critical action inquiry study, identification of the content was the result of a three-round Delphi study performed with experts from LAC and its comparison with the result of the Texas Tech University (TTU) professors survey to determine the topics and courses. Of the 91-originally-identified topics, 40 reached experts' consensus. The topics were then grouped into 23 courses. Faculty from TTU also ranked the courses. In the end, seven courses emerged from the research. The curriculum was approved and directed toward professionals in Latin America and the Caribbean. The courses for the online and face-to-face delivery of this multidisciplinary graduate certificate comprise the four pillars of food security and cross-cutting topics

Keywords

Delphi, food security, critical action research, curriculum, expert

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The purpose of the study was to determine the topics and courses of a graduate certificate focusing on Global Food Security (GFS) for Latin America and the Caribbean (LAC) through critical action inquiry. GFS is a major issue worldwide that will continue to expand in years to come. Almost 795 million people are estimated to have suffered from chronic hunger globally in 2014-2016. Studies have shown the strong relationship between education and food security and we do not argue for causation, merely association. For this reason, curricula focused on teaching GFS to graduate students will enable professionals in international settings to manage the complexities of food security more effectively. For this critical action inquiry study, identification of the content was the result of a three-round Delphi study performed with experts from LAC and its comparison with the result of the Texas Tech University (TTU) professors survey to determine the topics and courses. Of the 91-originally-identified topics, 40 reached experts' consensus. The topics were then grouped into 23 courses. Faculty from TTU also ranked the courses. In the end, seven courses emerged from the research. The curriculum was approved and directed toward professionals in Latin America and the Caribbean. The courses for the online and face-to-face delivery of this multidisciplinary graduate certificate comprise the four pillars of food security and cross-cutting topics.

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Introduction

With close to almost 800 million people still suffering from chronic malnourishment worldwide, global food insecurity continues to be a major issue at the forefront of discussions among policymakers across the globe (Food and Agriculture Organization of the United Nations [FAO], International Fund for Agricultural Development [IFAD], & World Food Programme [WFP], 2015a). According to the FAO (2009a p. 1), the definition of food security is: “when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” This definition addresses the four pillars of food security: Availability, Access, Utilization, and Stability (FAO, 2009a). Food insecurity is a complex problem that could be exacerbated as the population grows in years to come (Spiertz, 2012). This global problem affects all countries and needs to be addressed because “the situation is an affront to humanity dignity, a social disease and a threat to democracy” (Inter-Parliamentary Union, 1996, paragraph 2). Currently, the percentage of undernourished people worldwide has been reduced from 23.3% in 1990-1992 to 12.9% in 2014-2016 (United Nations [UN], 2015). However, when measuring the quantity of people, between 2014 and 2016, there were still 795 million people that continue to suffer from chronic hunger (FAO et al., 2015a).

The third target of the first objective of the UN Millennium Development Goals (MDG) was to reduce the proportion of people who suffer from hunger in half from 1990 to 2015 (UN, 2015). This third target was accomplished in over half of the developing countries; (FAO et al., 2015a). However, regionally, there are several differences in status of goal achievement (UN, 2015). In addition, the World Food

Summit (WFS) established the goal to “eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015” (FAO, 1996). This initiative was less successful than the first MDG, but still 29 developing countries did manage to achieve the objective of halving the number of undernourished people (FAO et al., 2015a).

The MDG and WFS challenges ended in 2015; for this reason, the UN proposed new strategies to eradicate poverty in all forms through the Sustainable Development Goals (SDGs) (UN, n.d.). The SDGs are much more ambitious than the MDGs because they pursue peace and freedom by 2030 (Sustainable Development Knowledge Platform, 2015). For this reason, efforts must be multiplied in order to accomplish the goals proposed by the UN to the world.

Food Security in Latin America and the Caribbean

Latin America and the Caribbean (LAC) is one of the most successful regions in reducing the percentage of undernourished people. This region reduced undernourishment from almost 14% to less than five, and the actual number of undernourished people decreased by almost half (FAO et al., 2015a). As a result of its progress, the region has accomplished the MDG and the WFS goals (FAO et al., 2015a). In spite of the overall progress in the region, work remains to be done. The most recent data indicate that food security in the region began to deteriorate, showing an increase in the percentage of undernourishment (FAO et al., 2017).

In January 2015, the Economic Commission for Latin America and the Caribbean [ECLAC, CELAC for its acronym in Spanish] signed the “Plan for Food Security, Nutrition, and Hunger

Eradication 2025” with the purpose of completely eliminating hunger by 2025 (FAO, ECLAC, & Latin American Integration Association [ALADI], 2015b; Food and Nutrition Security Platform, 2015). The plan consists of four specific components: human rights, stable food production, nutritional security, and expanding access to food (ECLAC, 2013).

By 2050, food production will need to almost double in order to ensure the food security of the global population that is estimated to reach 9.7 billion (UN DESA, 2015). Food insecurity is an important issue and because of its complexity, it is a long and difficult challenge and cannot be adequately addressed with only one strategy (FAO et al., 2015a). Consequently, different strategies to approach the problem have been identified (FAO, IFAD, & WFP, 2012). One of these strategies is through education.

Research indicates that education is a key component to address the food insecurity phenomenon. Education is a foundation for building skills, knowledge, and technical capacity in order to facilitate the development of the most vulnerable regions (IFAD, 2010). Education can increase people’s economic capacity; thus, facilitating greater food security through enhanced purchasing power (IFAD, 2010; Nordin, Boyle, & Kemmer, 2013). However, in order to provide a quality education, educators themselves need to have the necessary tools and knowledge to share with their students and stakeholders. Having educators, researchers, and other professionals with the necessary tools to combat food insecurity is fundamental in addressing the global food security challenge (Roberts, Harder, & Brashears, 2016). Thus, a curriculum in GFS must include as an objective the preparation of professionals to understand the problem and its possible solutions.

Conceptual Framework

This study is based on the Framework of Course Development Processes proposed by Graves (2000) focused on the needed steps for effective curriculum design (Figure 1). Graves suggests the model is not linear because a course design can start in any of the components (Graves, 2000). Designing a course is a dynamic process that involves different parties (Graves, 1996). The elements in the circles are the ones to be elaborated in this study, which are: defining the context, assessing needs, conceptualizing content, and formulating goals and objectives.

Defining the context was determined by the researcher; the curriculum will be a graduate certificate focused on GFS for LAC stakeholders. The certificate will be distance-delivered in order to reach graduate students throughout region. In conceptualizing content, the pillars of the course content have to be determined and articulated and will be used to frame the study. Assessing needs refers to students’ needs and how to better understand them. The Delphi study will provide the necessary information to determine the topics and courses of importance with the goal of preparing graduate students to overcome the regional challenges. The designer has also to formulate the goals and objectives to have a clear purpose and identify the outcomes. In this case, the goal of the certificate is to give students the necessary tools to gain knowledge related to food security, to make informed decisions, and prepare them for leadership positions. These three components will be determined using the results of the Delphi study. The remaining components of Graves’ model can then be elaborated by each instructor according to his or her beliefs and expertise.

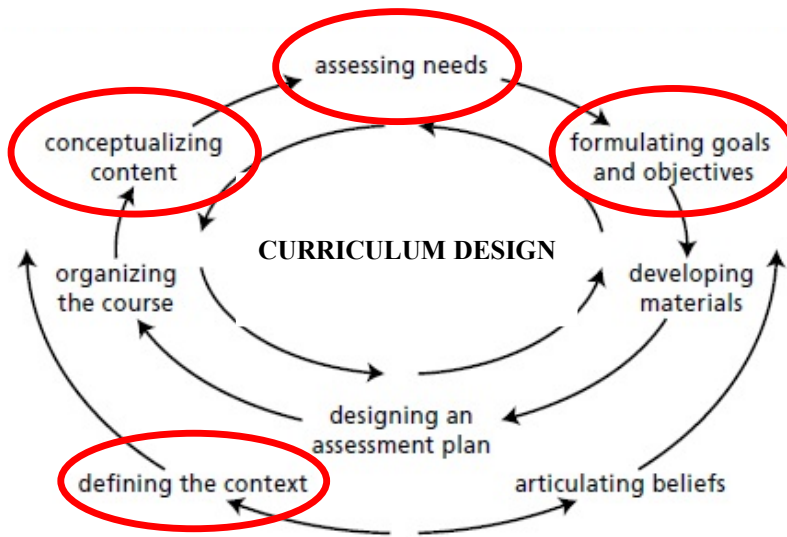


Figure 1. Adaptation of the framework of Course Development Processes and Components (Graves, 1996).

Purpose and Objectives

The purpose of the study was to develop a graduate certificate in GFS for Latin America and the Greater Antilles of the Caribbean through critical action inquiry. The following research objectives were developed to create an online graduate certificate focusing on GFS for LAC:

1. Identify the specific topics that should be included
2. Determine the specific courses that should be included

3. Compare the LAC and Texas Tech University (TTU) faculty selection of courses

Methodology

The study was designed as critical action research due to its application in curriculum development (Ary, Jacobs, Razavieh, & Sorensen, 2010). Critical action inquiry is participatory, helps to understand a phenomenon within a context, and the knowledge will ultimately result in social change (Mills, 2000). The study consists in three phases (Figure 2).

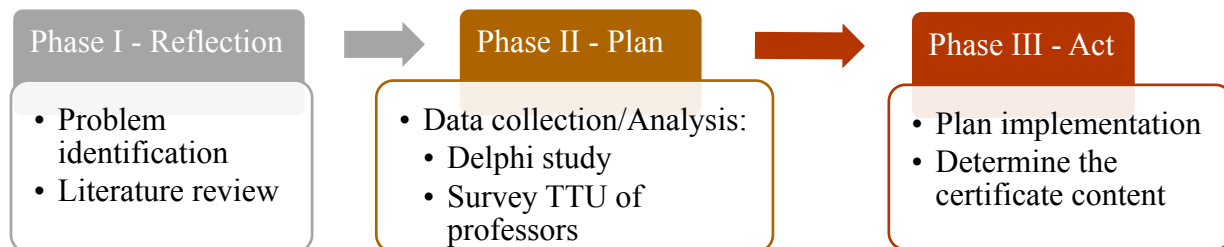


Figure 2. Adaptation of the Dialectic Action Research Spiral (Mills, 2000).

Phase I – Reflect

Gathering the information necessary to understand the problem (Mertler, 2009). Researchers reviewed the existing information related with food insecurity in the world and LAC, and the importance of education in reducing food insecurity.

Phase II – Plan

Collect the information needed (Ary et al., 2010). To complete this phase, a Delphi study and a survey to the professors from TTU were used.

Delphi study. The Delphi technique is recommended for curriculum development (Linstone & Turoff, 2002; Custer, Scarcella, & Stewart, 1999). This methodology utilizes experts related to a specific topic to arrive at a consensus (Turoff, 1970). The three-round Delphi study began after the approval from the TTU Human Research Protection Program.

Selection of the panel. Many Delphi studies have a sample size between 15-20 participants (Ludwig, 1997). The selection of the panel was made through a nomination process in which experts (members of academia and industry) involved in the topic nominated the individuals with expertise on food security in LAC (Anderson & Jones, 1986). The experts selected were from Latin America and the Caribbean mainly. Forty-two names of possible candidates were collected for the study. Individuals selected were members of academia and specialists in areas related to: agriculture, nutrition, food safety, policies, economics, rural development, food security, health, trade, program monitoring and evaluation, and emergency preparedness and response.

Round one. Before sending the email to the 42 experts identified in the selection process, five content experts reviewed the instrument that contained a single question: *What courses should be taught in a 15 hour-credit graduate*

certificate focusing on GFS? After their approval, an email was sent to the panel of experts describing the purpose of the research with a link to Qualtrics containing one question: Of the original 42 experts from Latin America and the Caribbean contacted to participate, 22 responded. Responses were condensed, analyzed, and sorted according to the four pillars of food security assuring all dimensions were covered in order to create the instrument for Round Two.

Round two. Participants received a list of topics and had to rank them according to level of importance from Strongly Disagree (1) to Strongly Agree (4). Consensus for inclusion was determined *a priori* when a topic achieved at least 75% of the panel agreement by either agreeing or strongly agreeing (Akers, 2000). Round two had a total response rate of 86%. Based on the results from the experts, topics reaching agreement were grouped into different courses through inter-observer agreement.

Round three. Experts were asked to rank the importance of each course for the graduate certificate. Experts used a 10 Likert-type scale that went from 1 = “Not important” to 10 = “Essential.” This round had a total response rate of 86%.

To assure a high response rate, follow-ups and thank-you messages were sent in all rounds of the study.

Survey of TTU professors. Based on the results of the Delphi study and following the critical inquiry process and the Course Development Framework. Researchers asked the input of TTU professors with expertise in the topics and the region. A 10-point Likert-type scale was developed based on the Delphi study and distributed to the professors. The items on the survey consisted of the 23 courses developed by the researchers. The instrument was previously pilot tested through the third round of the Delphi study. The group of professors who

ranked the courses to be included in the certificate consisted of fifteen professors from the College of Agricultural Sciences and Natural Resources and the Department of Nutritional Sciences in the College of Human Sciences at TTU.

This group had a total response rate of 100%. Following the same criteria of the Delphi Study, the courses that reached 75% agreement were considered for the creation of the certificate.

Data analysis. Results were exported to The Statistical Package for Social Science (SPSS®) v.22 for Windows database. Results were assigned with numerical values and summarized. Frequencies, percentage, averages, and standard deviations were used to evaluate the results. Hasson, Keeney, and McKenna (2000) suggest in order to achieve rigor, several elements should be considered; one of them is trustworthiness. A strategy

commonly used to achieve trustworthiness is inter-observer agreement; this strategy encourages researchers to analyze the results separately and then, compare results (Ary et al., 2010). Which was followed in the study to achieve trustworthiness.

Phase III – Act

Researchers implemented the plan (Mertler, 2009). Results of phase two were analyzed and compared. Finally, the comparison of the Delphi study and the survey of TTU faculty, gave as a result the courses and topics included in the graduate certificate.

Findings

Delphi Study

The results of the Delphi technique are summarized in Figure 3.

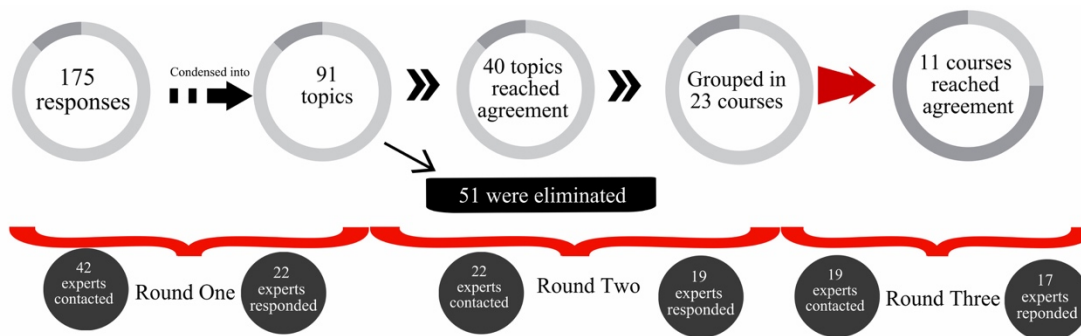


Figure 3. Three-round Delphi study design.

Round one. The open-ended question had a total of 175 item responses. The analysis of the responses produced a total of 91 topics that were divided in the following categories: access 13 (14.3%), availability 11 (12.1%), utilization 33 (36.3%), stability 7 (7.7%), general 27 (29.7%).

Round two. The results of the panel showed 40 topics reached more than 75% agreement. The topics with greatest agreement were *Food Safety* (87.5%), *Components of Food Security and Nutrition* (85.9%), *Causes of Food Insecurity* (85.9%), *Design, Monitoring, and Evaluation of Indicators in Food Security and Nutrition* (85.9%), *Information Systems*

and Assessment of Food Insecurity (85.9%), Surveillance and Early Warning (85.9%), Assessment of Food Security and Nutrition (84.4%), Comprehensive Analysis of Information Related to Food Security (84.4%), Strategies to Advance Food and Nutritional Security (84.4%), Design of Food Security Policies (82.8%), Marketing Surveillance in Food Security and Nutrition (82.8%), and Vulnerability in Food Insecurity (82.8%). In total, seven topics were selected from the access dimension of food security (17.5%), six topics were selected from the availability dimension (15%), eight topics were selected from the utilization dimension (20%), five topics

were selected from the stability dimension (12.5%), and fourteen topics were chosen from the general category (35%).

Researchers grouped the topics into 23 courses through the inter-observer process. In this process, five researchers independently grouped the topics into courses. Then, they gathered, reviewed, and compared their results. The courses were designed based on the topics with highest agreement reported on Round Two.

Round three and survey to the TTU professors. Responses of round three and the TTU survey are compared on Table 1 (see Table 1).

Table 1

Course Agreement LAC Experts (Delphi) and Professors from TTU

Course	LAC experts (n=17)			TTU professors (n=17)		
	<i>M^a</i>	<i>SD</i>	% of Agreement	<i>M^a</i>	<i>SD</i>	% of Agreement
Animal Production Systems	6.43	3.09	64.3	7.80	2.14	78.0
Economics	7.00	1.71	70.0	6.00	2.07	60.0
Effects of Climate Change in GFS	7.60	1.70	76.0	6.73	2.08	67.3
Entrepreneurship	5.92	1.89	59.2	5.86	1.99	58.6
Environmental Stewardship Systems	6.85	1.75	68.5	6.93	1.98	69.3
Epidemiology	7.33	2.39	73.3	5.73	2.26	57.3
Food Chemistry	6.43	2.97	64.3	5.29	1.87	52.9
Food Processing	7.62	3.03	76.2	7.20	2.43	72.0
Food Safety	8.79	1.61	87.9	8.93	1.18	89.3
Food Security Policy	9.07	2.12	90.7	8.87	1.36	88.7
Human Nutrition	9.33	0.79	93.3	8.33	1.58	83.3
Introduction to GFS	8.33	1.62	83.3	8.00	1.96	80.0
Knowledge Management	6.69	1.94	66.9	6.57	1.35	65.7
Logistics	6.00	2.30	60.0	5.86	2.33	58.6
Methods of Analyzing Food Security	8.43	1.95	84.3	7.93	1.88	79.3
Models of Food Production	7.47	2.39	74.7	7.40	2.22	74.0
Plant Production	6.92	2.69	69.2	6.87	1.71	68.7
Program Planning and Evaluation	8.50	1.35	85.0	6.33	2.65	63.3
Risk Management	7.82	1.80	78.2	6.50	1.84	65.0
Rural Development	7.46	1.39	74.6	7.33	1.92	73.3
Statistics	7.92	1.80	79.2	5.73	2.82	57.3
Sustainability	7.46	1.65	74.6	8.33	1.81	83.3
Water Issues	8.62	1.33	86.2	8.13	1.75	81.3

Note: Nine-point Likert-type scale. "1 = "Not important," 10 = "Essential,"

The results of LAC (Delphi) showed 11 courses reached more than 75% agreement. The topics with more than 75% agreement were Human Nutrition (93.3%), Food Security Policy (90.7%), *Food Safety* (87.9%), *Water Issues* (86.2%), *Program Planning and Evaluation* (85.0%), *Methods of Analyzing Food Security* (84.3%), *Introduction of GFS* (83.3%), *Statistics* (79.2%), *Risk Management* (78.2%), *Food Processing* (76.2%), and *Effects of Climate Change on GFS* (76.0%).

The results of the TTU professors showed eight courses reached more than 75% agreement. The courses were: *Food Safety* (89.3%), *Food Security Policy* (88.7%), *Human Nutrition* (83.3%), *Sustainability* (83.3%), *Water Issues* (81.3%), *Introduction of GFS* (80.0%), *Animal Production Systems* (78.0%), and *Methods of Analyzing Food Security* (79.3%).

The results of the Delphi study and the professors from TTU were compared and the average between the two groups produced the courses to be included in the certificate. There were some courses such as

Program Planning and Evaluation, *Food Processing*, *Effects of Climate Change in Global Security*, *Risk Management*, and *Statistics* that reached agreement according to the experts from LAC, but were not included because the average agreement from the experts at TTU was below agreement. On the other hand, the course *Animal Production Systems* had a high agreement with the experts from TTU, but the average agreement among experts from LAC was below 7.5 –equivalent to 75%. Consequently, it did not achieve agreement. The seven courses that reached agreement can be seen in Figure 4.

Seven courses reached agreement in order to be included in certificate. The courses were *Food Security Policy* ($M = 8.97$), *Food Safety* ($M = 8.86$), *Human Nutrition* ($M = 8.83$), *Water Issues* ($M = 8.37$), *Methods of Analyzing Food Security* ($M = 8.18$), *Introduction of GFS* ($M = 8.17$), and *Sustainability* ($M = 7.90$). The courses that reached agreement with their topics are shown in the Figure 5.

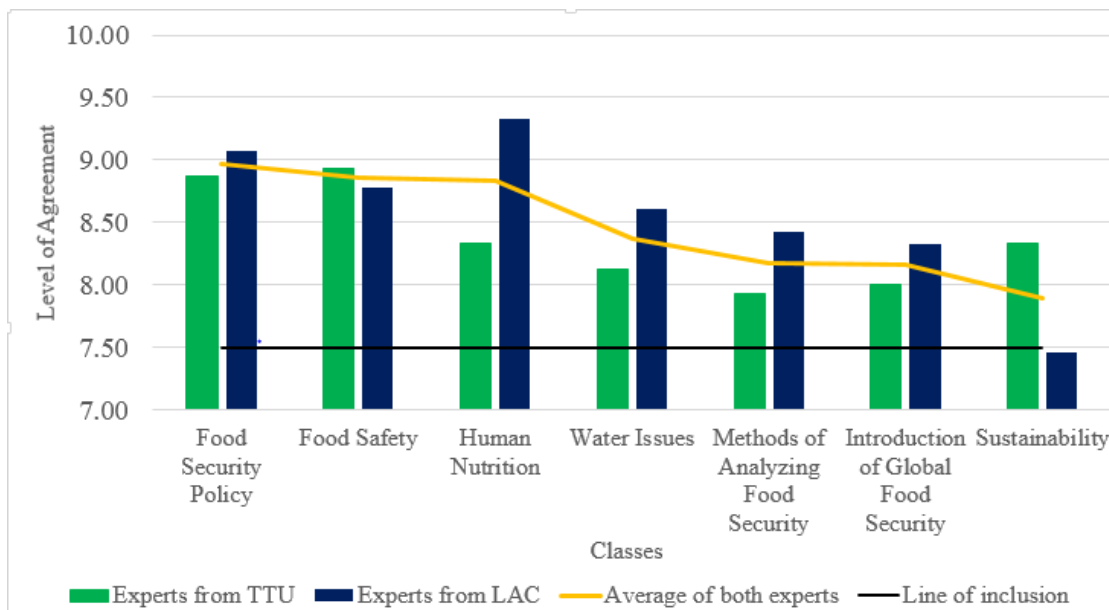


Figure 4. Courses that reached $\geq 75\%$ agreement level in final round.

Food Safety	<ul style="list-style-type: none"> • Food Safety • Foodborne Hazards • Good Manufacturing Practices
Food Security Policy	<ul style="list-style-type: none"> • Designing of Food Security Policies • Controls of Food Imports • International Institutional Architecture for Food Security
Human Nutrition	<ul style="list-style-type: none"> • Nutrition • Nutritional Problems in Developing and Developed Countries • Nutritional Surveys • The Global Problem of Disparity • Food Bio Fortification • Food Fortification
Introduction of Global Food Security	<ul style="list-style-type: none"> • Components of Food Security and Nutrition • Causes of Food Insecurity • Vulnerability in Food Insecurity • Food Availability • Conceptualization from the Universal to the Regional/National
Methods of Analyzing Food Security	<ul style="list-style-type: none"> • Information Systems and Assessment of Food Insecurity • Strategies to Advance Food and Nutritional Security
Sustainability	<ul style="list-style-type: none"> • Sustainability • Agroecology
Water Issues	<ul style="list-style-type: none"> • Water Access

Figure 5. Courses and topics included in the certificate.

The seven courses included 22 topics. These courses reached agreement necessary to be included in the certificate.

Conclusions, Recommendations & Implications

Objective one sought to identify the topics for the certificate. The panel of experts who participated in the study agreed 40 topics were appropriate for inclusion in the certificate. These topics were divided into the four pillars of food security, and a general category.

The topics *Food Safety*, *Foodborne Hazards* and *Good Manufacturing Practice*

are important to assure healthy food. It is important to guarantee safe and healthy food for society, as the pillar of food utilization promotes (FAO, 2009a).

The pillar of food utilization emphasizes the importance of nutritious food (FAO, 2009). The topics related to nutritious food were *Nutrition*, *Nutritional Surveys*, *Food Bio Fortification*, *Food Fortification*, “*Nutritional Problems in Developing and Developed Countries*,” and *The Global Problem of Disparity*. The region recognizes and is highly committed to the “nutritional wellbeing and assurance of nutrients for all vulnerable groups,

respecting the diversity of eating habits” (FAO et al., 2015b, p. 7).

The topics *Design of Food Security Policies, International Institutional Architecture for Food Security, Information Systems and Assessment of Food Insecurity* and *Strategies to Advance Food and Nutritional Security* are mainly related with stability. Leaders of these regions have to create appropriate policies focused on food security and nutrition to avoid falling into a price crisis that will affect the poorest and the economy in general (Committee of World Food Security [CFS], 2013; FAO et al., 2015a; IFAD, 2010). Facilitating good communication among countries will help to design a better system to make appropriate decisions from a regional perspective. In addition, program assessment on food security will clarify all the processes, promoting the transparency and effectiveness of the programs (FAO, 2014).

The topics *Food Availability* and *Controls of Food Imports* are also related to policies. Availability refers to the quantity of food that exists in the country (FAO, 2009a). The region is committed to assure food availability through “stable production and timely attention to socio-natural disasters” (FAO et al., 2015b). In addition, the topics *Sustainability, Agroecology*, and *Water Access* are mainly related with natural resources management. The region has also committed to having a sustainable access to food for all the population (FAO et al., 2015b). The adoption of sustainable and responsible agriculture is important to ensure the longevity of the production (FAO et al., 2015a). In addition, access to safe water is an important issue the region needs to address.

Objective two sought to determine the courses included in the curriculum. Experts who participated in the study agreed that 7 courses are the most appropriate for inclusion in the certificate. These courses

are: *Food Security Policy, Food Safety, Human Nutrition, Water Issues, Methods of Analyzing Food Security, Introduction of GFS, and Sustainability*.

The four pillars the ECLAC to eradicate hunger by 2025 are well represented in the courses. The courses *Food Security Policies* and *Methods of Analyzing Food Security* refer to the first pillar according to the ECLAC because the courses have topics related with policies and information systems. The second and third pillars are represented through the courses *Sustainability, Food Safety, Human Nutrition*, and *Water Issues*. The last pillar can be achieved through the courses *Sustainability* and *Food Security Policies*.

Objective three sought to compare the courses selected from the LAC experts with the courses selected by the TTU faculty. The seven courses proposed in objective two gathered consensus by both groups of experts: LAC and TTU faculty. However, there were some topics the experts from LAC considered essential for the certificate but the professors from TTU did not consider as fundamental. The course *Program Planning and Evaluation* reached agreement ($M = 8.50$) by the LAC panel; this is because the region is trying to make processes more transparent and to replicate programs with positive results (FAO, 2014). Program planning and evaluating are key factors for achieving food nutrition and security (Nordin et al., 2013). *Effects of Climate Change in Global Security*, and *Risk Management*, reached averages of 7.60 and 7.82, respectively. It is important to adapt and handle the impacts of climate change to guarantee food systems (UN, n.d.). Climate change is one of the biggest concerns in the region and there are serious damages that this phenomenon is causing (FAO, 2014; CFS, 2013). LAC is a region highly vulnerable to climate change because most of the countries are in tropical areas,

have fragile ecosystems, and are dependent on agriculture (FAO, 2009b). Having strategies to overcome the disasters in an integrated way is important for recovering faster from the damages (Global Facility for Disaster Reduction and Recovery [GFDRR] and The World Bank, n.d.). Finally, *Statistics* had an average of agreement of 7.92. This course is very important for stakeholders and decision-makers to help them understand the numbers involved with food security. It is important to gather accurate and reliable information with the purpose of making the right decisions (FAO, 2003).

There is one topic the experts from TTU considered essential for the certificate ($M = 7.80$) but the experts from LAC did not consider as fundamental: Animal Production Systems. Delphi studies will produce different results based on the expertise and the experiences participants have with the topic studied (Okoli & Pawlowski, 2004). When discussing a complex topic like food security, it is natural to have different perspectives based on the expertise of the group. However, it is important to acknowledge the differences and tried to come to consensus. Latin America is largely considered an excellent place for livestock and poultry production (FAO, n.d). The experts from Latin America prioritized other issues before the animal production systems based on their perspective internal to the region. Thus, issues they deal with on a day-to-day basis take precedence over the projected benefit of improved animal production systems. However, the experts from Texas Tech University considered investment in animal production systems important because of the potential the region has for enhanced animal production. Thus, animal production systems was included in the final list of topics.

Research using the Delphi technique reflects the expertise and diversity of the experts involved in the process. Understanding these complex issues will help leaders and stakeholders to make sound decisions about food security (IFPRI, 2015a). The topics and courses selected by the experts cover the four pillars of food security and are related to the four pillars of ECLAC to eradicate hunger in the region. Having professionals with knowledge in the four pillars of food security and the four pillars to eradicate hunger in LAC is important to accomplish the goal. The courses will prepare key stakeholders and leaders to make decisions armed with knowledge and accurate information regarding these issues. In addition, if professionals are educated about these topics they will be more aware of the challenges and possible solutions to overcome food insecurity.

Professionals who participate in this certificate are expected to acquire knowledge and transfer it to the most vulnerable populations as well as decision-makers and stakeholders. For this reason, follow-up studies will be conducted to measure the impact these professionals have on food security. People from countries that fight with food insecurity need to build capacities in topics related to agricultural practices, economy, and nutrition (CFS, 2013). Professionals with knowledge about food security who are willing to communicate the information are important for creating awareness on food security issues (Nordin et al., 2013). For this reason, transferring knowledge, especially to the most vulnerable groups, is important to the success of the region in accomplishing food security. Preparing graduates with knowledge of the complex phenomenon of food insecurity will help the region to confront the future challenges.

Some of the comments made by the experts were that some courses could be combined, for example *Animal Food Production* with *Plant Production* because farmers in LAC produce both in a small scale. Additionally, some experts commented as essential for the certificate but did not reach agreement is rural participation. Additionally, there is one aspect that was not included among the selected topics or the comments: economics. In the definition of food security, the word economics appears as an important factor, but this topic/course did not reach agreement. Researchers considered the course and the topics that reached agreement are related with economics and it will be indirectly taught. However, for future steps, it is important to take into consideration that economy is essential on food security. People need to have economic access to food, and decision-makers and key stakeholders need to be aware of this aspect when referring to food Security.

It is recommended to evaluate the courses every semester in order to maintain the quality and rigor of the certificate. This is an action research and, consequently, it is essential to design an assessment plan for the curriculum. In addition, keeping track of the professionals who complete the certificate and regular communications with these professionals, will provide the program faculty and institution critical effectiveness feedback.

Four of the classes are not included in the certificate based on selection results of the professors from TTU. Among the reasons, it is important to consider the lack of expertise available in the topics that were not selected. Gaining expertise in the areas we are lacking such as: water issues and the effect of climate change in global security is essential to providing a certificate that covers food security holistically.

Development and delivery of this multidisciplinary program will require the right faculty and support from administration to provide the resources to teach the courses. For this reason, it is important to find faculty with knowledge of these topics and this region. Faculty need to be aware the course must meet the necessities of LAC stakeholders. Additionally, it is important to include discussions, teamwork, and different activities to encourage networking. Students' personal experiences will enrich the learning. The exchange of experiences will help students to understand different initiatives in the region that can be duplicated (FAO et al., 2015b).

Future studies need to consider the importance of broadening representativeness and enough experts to cover the four pillars of food security. The selection of the experts is essential to have good representation and accurate results. It is important to emphasize that data is specifically for the region of LAC. The researchers encourage further studies in the region to understand the challenges on a smaller scale. The region of LAC can be divided in sub regions to better understand the individual challenges. Using a bigger sample of experts with wider variety of knowledge in the Delphi study, will generate more specific data.

A Delphi technique is a good strategy to gather the consensus of experts who are in different geographical regions. However, other strategies can be used to understand the challenges of food security in other regions of the world. Further research can be made in other regions of the world that are struggling with food security to create certificates according to their necessities.

From Research to Practice

Phase three of this critical action inquiry study, the action phase, resulted in

the ultimate approval of the curriculum. After the results of the study were shared with the faculty and administration of TTU, some changes were made and the faculty from the International Center for Food Industry Excellence [ICFIE] worked to make the certificate available for students. As a result, the certificate focused on GFS started on January 1st, 2016.

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