Higher Education for Development (HED)
and
U.S. Agency for International Development (USAID)

"Development of agronomy and crop production academic programs, research, and need based extension programs for sustainable food production in Senegal"

December 21, 2010 – September 29,2015

FINAL ASSOCIATE AWARD REPORT
September 2015

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PARTNERSHIP INFORMATION

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Secondary Partner Institutions: University of Gaston Berger
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List of Acronyms

ACE	American Council on Education
BSc	Bachelor of Science
CIDA	Canadian International Development Agency
GFSR	Global Food Security Response
GOANA	Grand Offensive for Food and Abundance
GRE	Graduate Record Examination
HED	Higher Education for Development
HICD	Human and Institutional Capacity Development
IPM	Integrated Pest Management
M&E	Monitoring and Evaluation
MS	Master of Science
NGO	Non-Governmental Organization
NSF	National Science Foundation
OSU	Ohio State University
OSU SMT	Ohio State University Strategic Management Team
PDMA	Partnership for the Development of Agricultural Markets
PhD	Doctorate Degree
PRIME	Partnership Results & Information Management Engine
RDA	Regional Development Agency
TOEFL	Test of English as Foreign Language
UF	University of Florida
UGB	University of Gaston Berger
UGB-ARDC	University of Gaston Berger Agricultural Research and Development Center
USAID	United States Agency for International Development
USAID/AFR	United States Agency for International Development/Africa Bureau
USG	United States Government

1. Executive Summary

This final report, covering the period from December 20, 2010 to September 30, 2015, refers to Associate Cooperative Agreement No. 685-A-00-11-00023-00 between USAID/Senegal and the American Council on Education's Higher Education for Development office (ACE/HED) and a sub-cooperative agreement between the Ohio State University (OSU) and ACE/HED.

2. Partnership Overview

Background
The partnership between Université Gaston Berger and the Ohio State University was funded by USAID through HED's Leadership with Associates' Award, as part of the Africa-U.S. Higher Education Initiative. The Africa Initiative was started with 33 U.S. and African partnerships receiving six month planning grants for proposal development. Of the 33 planning grant proposals presented, the partnership between UGB and OSU was one of eleven finalists selected for funding.

Although the Africa Initiative's final eleven partnerships had started as a program defined by a "five year program, ten year vision," changes in U.S. Government administration resulted in foreign policy and budgetary changes that dramatically affected all partnerships within the Africa Initiative.

ACE/HED and USAID/Senegal signed an Award Agreement effective December 21, 2010. The award was for a partnership between UGB and OSU, titled "Development of Agronomy and Crop Production Academic Programs, Research, and Need-Based Extension Programs for Sustainable Food Production in Senegal." However, by the end of USAID Administrator Raj Shah's first year, USAID strategies and funding priorities had undergone a "hard pivot" and the funding for the USAID Senegal Mission, and this partnership, was significantly reduced. Thus, the original partnership goals and vision underwent major changes as the original proposal with a $5M budget was cut back to roughly $1.5M to accommodate the reduced budget levels. Despite these enormous budget cuts, the partnership was still able to achieve significant results that will have lasting impact.

Goals and Vision
This collaboration between UGB and OSU, in partnership with national research institutions, non-governmental organizations (NGO), and other stakeholders was designed to create the long-term professional capacity to solve agricultural management challenges in the fragile northern Senegal and Sahelian ecosystems. The partnership developed an innovative agronomy and crop production degree program and established the University of Gaston Berger Agricultural Research and Development Center (UGB-ARDC) based at UGB in St. Louis, Senegal. The Center has positively impacted agricultural higher education in Senegal and throughout the Sahel. The graduates of the program are trained to address the ecological and agricultural challenges of this fragile, semi-arid environment and provide the human capacity to serve the emerging food export industry.

Partnership Objectives
Phase I (FY 2012 to FY 2013):

1) Implement Associate and B.S. degrees programs in agronomy and crop production at the UGB.
2) Improve the capacity of faculty at UGB through "sandwich" PhD studies, faculty exchanges, mentoring programs and short-term training in agronomy and crop production program.
3) Provide effective applied research and extension service through a pilot integrated research and outreach program.

4) Strengthen the newly established departments of the College of Agriculture, Aquaculture and Food Technology at UGB through improved laboratory and teaching facilities.

Phase II (FY 2014 to FY 2015):

1) Improve human capacity at UGB in the Department of Agricultural Sciences, Aquaculture, and Food Technology.
2) Provide effective applied research and extension service through a pilot integrated research and outreach program.

Collaborating Stakeholders

The OSU-UGB partnership worked with five of collaborating stakeholders to achieve their partnership objectives, including short-term trainings and conducting joint research. Green Senegal, a local NGO and Producteurs de Ndialakhar, a local group of farmers, worked with the partners to conduct participatory research at the farmers' level, enhancing the relationships between farmers' associations and UGB. Green Senegal worked with UGB to conduct an assessment of the strengths and weaknesses of the agricultural production techniques of producers in three villages: Pont Gendarme, Gandiaye, and Ndialakhar. Producteurs de Ndialakhar worked on vegetable crops under irrigated conditions that were facing low productivity issues mainly due to lack of production management. UGB faculty and students in conjunction with Green Senegal observed the methods the farmers used for growing onions and tomatoes and discovered that the farmers were not employing appropriate conservation agricultural practices.

Institut Senegalais de Recherches Agricole (ISRA) and GIE Agritech both contributed to the successful launch and expansion of the mechanical transplanter trainings with small holder farmers in the Senegal River Valley. Both organizations worked with the partnership to spread awareness among the farming communities and better explain the technical process and crop yielding advantages of the mechanical transplanter.

<u>Community Organizations</u>

- Producteurs de Ndialakhar
- Producteurs de Pont Gendarme

<u>Non-Government Organization/Business</u>

- Green Senegal
- GIE Agritech

<u>Government</u>

- Institut Senegalais de Recherches Agricole (ISRA)

3. Partnership Results and Performance

This section presents results and performance against the end of partnership targets. Structured around the partnership's M&E plan, the following section examines the partnerships' achievements and progress in relation to the objectives, outcomes and outputs as envisioned and designed by the partners.

Achievements and Implementation Progress

Phase I (FY2012 to FY2013)

Objective 1: To implement Associate and B.S. degrees programs in agronomy and crop production at the UGB.

Outcome 1.1: UGB's capacity to deliver a complete degree program in Agronomy and crop production is established.

Curricula

During Phase I of the partnership, the OSU Strategic Management Team worked closely with the UGB faculty and administrators of the newly formed Department of Agriculture, Aquaculture, and Food Science Technology, to assess the needs of the university and the region through a baseline assessment of the current training at UGB. This baseline assessment demonstrated the need to create two new programs, an Associate and Bachelors of Science degree programs in Agronomy and Crop Production. The goal of these two degree programs was to train its graduates in the principles of Agroecology and hands-on experience in order to improve agricultural production while ensuring crop sustainability. In addition to teaching these new principles, these progressive programs, both new to West Africa, emphasized the link between the producer and the consumer, the important differences between rural and urban community interactions, and food safety. The Consent Decree authorizing the two programs was signed by the Minister of Higher Education in Senegal in FY12.

Experiential and/or Applied Learning

The UGB-OSU partnership introduced a new mandatory annual internship program into their Associate and Bachelor degree programs, which allows students to work with local farmers, NGOs and businesses to gain experiential and/or applied learning experience. Each student's internship experience is graded both by their host organization and by the student report presented to their professors at the end of the internship. In FY13, 92 students completed an internship at 19 different organizations including national research institutes, national extension organization, NGO's, farmer cooperatives and private businesses.

Outcome 1.2: Improved faculty capacity for teaching skills in agronomy and crop production

Short-Term Training

In Phase I, the UGB-OSU partnership conducted 13 short-term trainings and trained 185 participants, including 48 females and 137 males (Table 1). The four short-term trainings held in FY12 consisted of two workshops on Weed Ecology, a ServSafe Employee training and trainings through the OSU-UGB faculty mentoring program. The Weed Ecology workshops were conducted at UGB by a visiting OSU weed scientist, who worked with UGB students and faculty to determine the long-term effects of vegetation management on weed communities and seeds in the soil seed bank.

In FY13, the partners conducted nine short-term trainings and study tours, which improved the skills of UGB faculty and staff in areas of grant writing, research skills, and knowledge in the Land Grant model. Five UGB faculty members (Michel Diop, Pape Sher Diop, Justin Kantoussan, Racine Samba Sow and Saidou Sall) traveled to OSU to conduct faculty study tours, which allowed these Senegalese professors to observe and learn from the concepts of the U.S. land grant university system, to observe extension activities, and to collaborate with U.S. professors and researchers on the development of a project

proposal. During their study tours, they were able to attend classes on food microbiology and had discussions with a number of faculty and staff members of the OSU Food Science and Technology Department and the Food Industry Center (FIC). The visiting UGB faculty attended lectures and laboratory demonstrations in their discipline to observe teaching methods and styles, attended workshops at the University Center for the Advancement of Teaching, visited the OSU South Centers and the Ohio Research and Development Center where they learned about the extension work and research conducted at OSU, and went on several field trips with their mentors across the state of Ohio.

The mechanical transplanter demonstration, piloted in December 2012, was one of this partnership's most successful activities. OSU Extension Educator, Brad Bergefurd conducted trainings and demonstrations on how to use the newly purchased mechanical transplanter which allows quicker, more accurate transplantation of seedlings with much less labor. Although it is a relatively simple technology, it has the potential to transform the way farmers grow their crops in Northern Senegal and consequently had the highest attendance.

Table 1
Phase I Short-Term Trainings in Phase I: FY12 to FY13

FY	No.	Short-Term Training Activity	Number of People Trained		
			Female	Male	Total
FY12	1	Weed Ecology Field Exercise (Workshop 2)	5	16	21
	2	Teaching Weed Ecology through a Field Exercise (Workshop 1)	6	15	21
	3	OSU-UGB Faculty Mentoring	1	3	4
	4	ServSafe Employee Training	0	1	1
FY13	5	Michel Bakar Diop Study Tour at OSU	0	1	1
	6	Mechanical Transplanter Pilot Training	21	67	88
	7	Project Management Training	1	0	1
	8	Tomato Blight and Polyculture Training	7	13	20
	9	Pape Sher Diop OSU Study Tour	0	1	1
	10	Justin Kantoussan OSU Study Tour	0	1	1
	11	Racine Samba Sow OSU Study Tour	0	1	1
	12	Saidou Sall OSU Study Tour	0	1	1
	13	How to Conduct a Produce Auction	7	17	24
Total Participants			48	137	185

Long-Term Training (Enrolled)

In Phase I, the partners enrolled 239 individuals (49 female and 190 male) in long-term training activities, including the Agronomy Bachelor degree program, the Agroecology Associate degree program, and Agricultural Engineering degree program (Table 2). After successfully passing his Test of English as Foreign Language (TOEFL) and Graduate Record Examination (GRE), Mr. Lamine Diop was enrolled the Agricultural Engineering degree program in FY13 and continued his PhD studies in Phase II of the partnership. Although not reported, Weed science PhD student, Mr. Cesar Bassene worked on the American Language Program during FY13 in order to prepare to take his TOEFL and GRE exams and enroll in a sandwich PhD program in Phase II.

Table 2
Long-Term Training (Enrolled) in Phase I: FY12 to FY13

Degree Program	FY12			FY13		
	Female	Male	Total	Female	Male	Total
Bachelor	26	97	123	0	0	0
Master's	0	0	0	0	0	0
Doctorate	0	0	0	0	1	1
Associate	23	92	115	0	0	0
Overall	49	189	238	0	1	1
TOTAL	239					

Outcome 1.3: Research & Development Centers created and operational.

Joint Research

The partners initially planned to conduct two research projects in FY13, which unfortunately had to be cut back because of insufficient funding. The partners did submit two joint research project proposals to the Bill and Melinda Gates Foundation for outside funding. Unfortunately, neither received funding.

Objective 2: To improve the capacity of faculty at UGB through sandwich PhD studies, faculty exchanges, mentoring programs and short-term training in agronomy and crop production program.

Outcome 2.1: Access to degree programs in Crop Production and Agronomy for Senegalese students is established.

Access

The Associate degree program, developed and launched in Phase I, reported 141 individuals enrolled from underserved and/or disadvantaged groups in FY12 and FY13 (Table 3). However, there are two important discrepancies with this figure. First, male students (92 Associate Degrees and 97 Bachelor Degrees) were not counted in the FY12 figure and second, the two PhD candidates (Mr. Diop and Mr. Bassene) in FY13 were not counted. If those students had been recorded during the correct reporting period, the total would have been 332 individuals (81 female and 251 male) accessing tertiary education programs.

Table 3 **Number of Individuals from Disadvantaged and/or Underserved Groups Accessing Tertiary Education Programs in Phase I: FY12 to FY13**				
FY	Degree Programs	Individuals		
		Female	Male	Total
FY12	Associate Degree	23	0 *[92]*	23 *[115]*
	Bachelor Degree	26	0 *[97]*	26 *[123]*
FY13	Associate Degree	32	60	92
	Bachelor Degree	0	0	0
	Doctorate	0	*[2]*	*[2]*
TOTAL		81	60 *[251]*	141 *[332]*

Objective 3: To provide effective applied research and extension service through a pilot integrated research and outreach program.

*Outcome 3:1: UGB has increased capacity to provide community access to resources, increase awareness, and provide training through linkages and networking***.**

Outreach/Extension Activities

In Phase I of this partnership, the partners completed four outreach/extension activities (Table 4). The partners held a two training sessions for Senegalese farmers in FY12. The first outreach activity brought together 22 farmers and UGB faculty to discuss and explain the slow growth of peanuts (a high-value cash crop) in the Senegal River Valley Delta. The farmers discussed their crop yields and challenges and the UGB faculty explained the environmental factors affecting the crops, like the relatively high salinity levels in the soil. The second outreach activity brought together members of the OSU-UGB project team and 18 farmers, representing 6 associations to explain their relatively low yield in onion and tomato production beyond the cool and dry growing season. After hearing the farmers' issues, the OSU-UGB project team was able to explain that these low yields were due to the nature of the seeds, insect and microbial infestation, the lack of availability of fertilizers and the means of application. This outreach activity was very well received and the project team and farmers engaged in a very dynamic discussion of onion and tomato farming.

In FY13, the partners conducted two outreach activities where students from the bachelors program conducted crop surveys in two farming villages, Pont Gendarme and Ndiallakhar. These activities allowed the students to work with the farmers to collect information on insects infesting crops in farmers' fields and help design interventions. The survey collected information on tomato and onion insects, diseases and crop protection practices. Among their findings, the students found that the farmers at Pont Gendarme were applying pesticide simply based on the calendar and not based on the likelihood of insect infestation or disease. In order to determine the correct time for pesticide application, the students set insect traps in farmers' fields, collected samples, and used their findings to develop an integrated pest management (IPM) system.

Table 4 Outreach/Extension Activities in Phase I: FY12 to FY13		
FY	No.	Type of Activity
FY12	1	Training session on growth of peanuts
	2	Activities designed to explain the inhibiting factors of tomato and onion growth
FY13	3	Survey on tomato and onion insects and diseases
	4	Survey on crop protection services

Objective 4: To strengthen the newly established departments of the College of Agriculture, Aquaculture and Food Technology at UGB through improved laboratory and teaching facilities.

The partners originally intended to achieve this objective through funding joint research projects and developing new or improved policies increase access to tertiary education. However, reductions in project funding by USAID prevented the partners from implementing these activities. As noted in the challenges section, this funding cut in the second year of implementation and resulted in a number of restraining effects on the project, including loss of personnel and suspension of activities to avoid overspending the approved award amount.

Phase II (FY 2014 to FY 2015)

Objective 1: To improve human capacity at UGB in the Department of Agricultural Sciences, Aquaculture, and Food Technology.

Outcome 1.1: Improve faculty capacity for teaching skills in Agricultural Sciences, Aquaculture, and Food Technology.

Long-Term Training

In Phase II, 67 individuals completed long-term training in the Associate Degree program and one trainee completed their doctorate degree (Table 5). UGB's inaugural Agroecology Associate Degree graduating class completed their two-year program with 66 graduates (21 female and 45 male) in FY14. The partnership continued supporting the two PhD candidates; Mr. Lamine Diop and Mr. Cesar Bassene. Weed science PhD student, Mr. Bassene, was originally funded to pursue his degree at OSU but was transferred to the University of Florida (UF) so that he could work with a specific professor in a discipline that wasn't offered at OSU. Mr. Bassene returned to Senegal in the spring of FY14 for personal/family reasons and cancelled his plans to return to the U.S. to complete the program.

Mr. Bassene completed his PhD program in April 2014 at the Université Cheikh Anta Diop (University of Dakar) in Senegal. Mr. Bassene received his doctoral degree through the Graduate School of Life Sciences and Environmental Health with his doctoral thesis on "Weed flora in maize/corn cultures (Zea mays L.) in the southern peanut basin: structure, harmfulness/negative impact, and elaboration of a weeding method" ("La flore adventice dans les cultures de maïs (Zea ruays L.) au sud du Basin arachidier : structurc, nuisibilité et mie au point d'une méthode dc désherbage"). After completing his PhD program, Mr. Bassene declined to continue further studies at UF for personal reasons and he is currently employed as an assistant professor at UGB.

Mr. Diop presented his research proposal to his PhD Advisory Committee and he sat for his candidacy exam on May 11, 2015. After completing his exam, he returned to Senegal with his OSU PhD advisor, Dr. Larry Brown to set-up his doctoral thesis and conduct his PhD research. Mr. Diop will use outside funding to return to OSU for one semester after the data is collected and his dissertation is written to defend his dissertation and graduate. During his time at OSU, Mr. Diop received training at the Arkansas Rice Research and Extension Center on scheduling irrigation, soil moisture, and energy efficiency for irrigation.

Table 5
Number of Host-Country Institution Individuals Who Completed Long-Term Training Program in Phase II: FY14 to FY15

	Degree Program	Female	Male	Total
FY14	Associate Degree	21	45	66
	Doctorate	0	1	1
TOTAL		67		

Short-term Training

There were eight short-term trainings conduct during Phase II of the OSU-UGB partnership (Table 6). These trainings included seven UGB faculty and/or staff study tours at OSU and one seminar on shrub-intercropping, Aquaculture, and Agricultural Drainage Seminars. OSU Professors, Richard Dick, Larry Brown, and Konrad Dabrowski traveled to Senegal to assist PhD candidate, Mr. Diop with developing his in-country research, and for Dr. Dabrowski to investigate potential aquaculture research opportunities with UGB faculty members. During their trip to UGB, the OSU professors presented a series of seminars for UGB faculty and students. This seminar series reached 48 participants (12 female and 36 male).

Table 6
Short-Term Trainings conducted in Phase II: FY14 to FY15

FY	No.	Name	Number of Individuals		
			Female	Male	Total
FY14	0	No Trainings	**0**	**0**	**0**
FY15	1	Mateugue Diack Study Tour	0	1	1
	2	Michel Diop Study Tour	0	1	1
	3	Amy Sougou Study Tour	1	0	1
	4	Saidou Sall Study Tour	0	1	1
	5	Mariama Sene Wade Study Tour	1	0	1
	6	Ngone Beye Study Tour	1	0	1
	7	Mouhamahou Ly Tour	0	1	1
	8	Shrub-intercropping, Aquaculture, and Agricultural Drainage Seminars:	12	36	48

	8.1	"Rhizosphere hydrology and microbiology of shrub-intercropping: A system to resist drought stress and optimize yields of dryland farming in the Sahel" (presented by Dr. Dick)			
	8.2	"Agricultural Drainage in the Midwest USA: Use and Management for Water Quantity and Quality" (presented by Dr. Brown)			
	8.3	"Research goals in improvement of major aquaculture limitation: replacement of fish meal with plant protein sources in aquafeed utilization" (presented by Dr. Dabrowski)			
TOTAL			15	40	55

Objective 2: To provide effective applied research and extension service through a pilot integrated research and outreach program.

Outcome 2.1: Effective applied outreach and extension program is implemented.

New Research Activities

There were seven research proposals submitted in FY14, of which, six were funded and one is still pending approval (Table 7). Although six of these proposals have been funded, they are still in the early stages of implementation.

Several of the OSU-UGB mentoring teams are committed to continuing research collaborations after the end of the award, including the Director of the OSU Food Industries Center, Valente Alvarez and Dr. Michel Diop who are currently developing a business plan for the UGB pilot food industries center to achieve financial sustainability. Five OSU faculty mentor teams will also continue to work and develop joint research proposals and two UGB faculty plan to return to OSU to continue research and collaboration with their OSU mentor. After the end of the award, Dr. Brown will continue to work on joint research with PhD candidate Lamine Diop until his graduation in December of 2017.

The Partnership between OSU and UGB will continue to develop and submit joint research proposals after the close of the award. On March 5, 2013 an extension of the Memorandum of Agreement between OSU and UGB was signed guaranteeing collaboration through July 22, 2018.

Table 7
Research proposals submitted in Phase II: FY14 to FY15

FY	No.	Proposal	PI	Funding Institution	Amount Requested
FY14	1	Restoration of degraded lands affected by salinization process for food security in Senegal	Mateugue Diack	Ministry of Higher Education (Senegal)	37,200.00 – Pending
	2	Dynamics of Farmlands in the Niayes region and its	Mateugue Diack	Periperi U / USAID	16,800.00 – Funded

		relationship to food insecurity in Senegal			
	3	Gestion raisonnee des enemies des Solanacees maraicheres et amelioration de la qualite sanitaire des produits dans le delta et la moyenne vallee du fleuve Senegal	Amadou Bocar Bal	Periperi U / USAID	15,000.00 – Funded
	4	Effect de la variation de la temperature sur l'alimentation et la croissance de Oreochromis Niloticus – Pisciculture et Changement Climatique	Mamaoud Amadou Ly	Periperi U / USAID	3,600.00 – Funded
	5	Gestion des risques phytosanitaires et de disponibilite des semences de bananiers dans le delta et la vallee du fleuve Senegal	Papa Madiallake Diedhiou	Periperi U / USAID	15,000.00 – Funded
	6	Competences et strategies des acteurs de la vallee du fleuve Senegal pour la gestion des risques naturels et de la vulnerabilite pour la securite alimentaire : Etat des lieux et perspectives	Amadou Ndiaye	Periperi U / USAID	6,000.00 – Funded
	7	Vulnerabilite des sols rizicoles face a la progression de la salinization dans le delta du fleuve Senegal: les benefices compares du phosphogypse, des engrais organiques et du biochar pour la restauration	Saidou Sall	Periperi U / USAID	10,000.00 – Funded

Challenges

Project Funding Uncertainty

As noted earlier in the Background section, the funding uncertainties surrounding the Africa Initiative, including this partnership, made forward planning difficult for the partners. The incremental funding system implemented was new to both institutions and resulted in a number of planning delays, which were further complicated by the delay in receiving the second tranche of funding. For example, prior to receiving notice of possible delays in the second tranche of funding, UGB had already signed on two new PhD students and scheduled a pending training at OSU in Agricultural Engineering and Weed Science. This delay created an uncertain funding future of the project and consequently, one of the highly sought-after PhD students backed out of the program. Losing this PhD candidate was a major blow to UGB and the project, particularly because it is difficult to find qualified females for academic positions in Senegal.

Difficulty with PRIME

At the end of the first year of implementation, HED initiated PRIME, an on-line software for results reporting. The Senegalese partners, cited the lack of training and familiarity with PRIME as a barrier to their ability to, provide data on a timely or efficient basis. Partners advocated for a less "complex" reporting system (such as that used by NSF). Their suggestions for the improvement of the PRIME

system, noted in the partners' final report, were helpful to HED as it worked with its vendor to improve the system.

PhD Student Recruitment
PhD student recruitment is a process that took longer than typical student recruitment in the United States. The reason is that the candidates being recruited are also hired at UGB as professors, which requires a much higher level of scrutiny and approval by the UGB faculty, administration, and the Ministry of Education. Although the process is long, ultimately it is desirable for long-term faculty capacity building.

Building Awareness about the New Agronomy Department
Because the Agronomy Department at UGB is still new and developing, it continues working on increasing its visibility in the community and letting farmers, organizations, businesses, and other stakeholders know about the Department and what they have to offer. Along this same line, building partnerships with small farmers can be slow because of the newness of the Department. The Department is working on building its track record with farmers so that word-of-mouth promotion will continue, as well as increasing its visibility in the community whenever possible. Although raising awareness of UGB's Agronomy department has been slow process, the partners have already made significant strides.

Difficulty Combining Reaching and Research Activities at UGB
UGB worked to adopt the American university system based on the combination of teaching and conducting research. This faculty requirement was a big challenge for UGB. In order to facilitate this shift, the partners planned a number of faculty study tours at OSU so that the UGB faculty could work with mentors in their respective fields. During these study tours, UGB faculty were trained in the use of laboratory and field equipment that have been purchased through the award to promote and conduct research.

Challenges with U.S. University Entrance Exams
Due to low GRE and TOEFL scores the PhD candidate, Mr. Bassene was unable to enter the Weed Science degree program in the FY13 Summer Semester as originally planned. In order to improve his English language skills, the partnership enrolled Mr. Bassene in a language course, which he successfully completed and gave him the language skills necessary to pass the entrance exams in FY14. English language skills are a necessary but difficult prerequisite for all higher education programs in the U.S. The lack of high level language skills at UGB made it difficult for the partners to find qualified candidates. OSU and UGB plan to incorporate English language training into future long-term training projects.

UGB Faculty Member Unable to Engage in U.S. Long-term Training
Dr. Bassene was originally scheduled to attend UF under the direction of Dr. Carlene Chase, an expert in tropical weed ecology, to continue work on developing collaborative research in weed science in FY15. After several weeks of trying to reach Mr. Bassene it became clear that he did not want to come to the U.S. to work with Dr. Chase. The partners are still unclear about what caused this dramatic change because Mr. Bassene had expressed his continued desire to work with Dr. Chase. Mr. Bassene continued to express his commitment to the program as the visa process moved forward but he abruptly stopped responding to OSU and UGB when asked to set up his visa interview. After several phone calls with UGB contacts, Mr. Bassene's intentions to continue the program were still unclear. To accommodate the delays, UF extended the deadline for his arrival one month into the semester. Due to the lack of response, it was decided to stop all efforts to reach Mr. Bassene. The lack of responsiveness from Mr. Bassene was very frustrating for Dr. Chase, OSU and UGB, as all involved had spent a significant amount of time setting up a new sub-subaward with UF, developing relationships with the faculty and

staff in the UF Horticulture department, setting up the logistics for the trainings, and trying to locate Mr. Bassene.

Although the partnership expended a lot of time and effort during this process, no money from the partnership budget was lost. Wanting to provide an equal type of programming, the partnership reallocated resources to two new UGB Faculty members who have their Master's Degree and would benefit greatly from training at OSU with mentor professors. With the Mission's approval, the two UGB faculty members, Ngone Beye and Ly Mohamadou were set up with OSU mentors in Food Science and Aquaculture respectively. These additional trainings and the development of collaborative research provided the foundation for Mr. Mohamadou and Ms. Beye to begin their PhD training after the end of the award.

Annual Targets and Reporting
During the planning process, inaccurate FY14 projections and targets were set because the partners misinterpreted the definitions of some indicators. For example, the FY14 target for long-term training completed was zero because OSU believed that this only referred to graduates of OSU (the two PhD students from UGB) and not the graduates from the new degree programs at UGB. This misunderstanding was addressed during HED's annual data quality verification process and consequently the 66 graduates from the associate degree program were included in FY14's long-term training results.

Complex Reporting Software
The UGB program team was initially unable to appoint a specific person to oversee M&E reporting and did not feel that the trainings offered by HED were sufficient to properly enter data into PRIME. Consequently, the UGB partners were unable to input their own data and information, which resulted in underreporting of important activities. The reporting quality improved in FY14 and FY15, when OSU appointed a program manager, who worked closely with HED to make sure that data on progress for each indicator were reported properly.

Lessons Learned

Need for Administrative and Contract Management Team
Initially, there was some lack of clarity and understanding among the UGB faculty about the project and how the funds were being spent. The UGB management team adopted a policy of transparency and a rotating administrative team made of UGB Agronomy faculty. Because of the transparency and the value the faculty has seen in the OSU study tours and other project initiatives, the UGB faculty's approval and interested in the project improved significantly. This "case study" demonstrates the importance of communication and effective leadership.

Unexpected Outcomes
Data generated from crop survey and insect traps have been very useful in providing technical support to farmers. This data demonstrated the need for farmers to establish schedules between application and time of infestation, rather than adhering strictly to calendar schedules. The information collected through insect traps has enabled strengthening research capacities and also identify the type of pests infesting crops and in developing an integrated pest management system for Northern Senegal. This is exciting research that could transform the way pests are controlled in this region to the benefit of all.

Mechanical Transplanter Issues
Retrofitting the mechanical transplanter to work with horses rather than a tractor was an enormous mechanical achievement. Now that the know-how is in place to transform transplanters, more of these

inexpensive devises can be imported to Senegal, potentially transforming the way small farmers do business and resulting in higher crop yields.

Flexibility needed with unanticipated changes in the implementation plan.
The unforeseen change in activities with Mr. Bassene emphasized the partners' need for back-up plans, flexibility, and also the need to not take things personally. The OSU program manager expended a significant amount of time and energy in attempting to contact Mr. Bassene and convince him to return to the U.S. to complete his studies at the University of Florida. However, he was unresponsive and the program manager had to shift her focus quickly to maintain the other activities supported through this partnership.

More training needed to successfully pilot the mechanical transplanter.
After piloting the mechanical transplanter in FY12 and following up with the farmers trained, it was clear that the required additional trainings in order for the new technology and methodology to be implemented effectively. To facilitate this, OSU Extension Specialist planned to travel to Senegal twice in FY15 to assist partners with troubleshooting and transplanter maintenance but was unable to conduct these additional trainings due to budgetary constraints. Although the transplanter is a relatively simple technology, it has the potential of transforming the way farmers grow their crops in Northern Senegal. In order to be used effectively, it requires training both in maintenance of the machine and proper use in the fields.

4. Success Stories

The Lasting Impact of Agronomy and Crop Production Program Internships

Having grown up in the bustling metropolis of Dakar, Aby Cisse has not had many opportunities to experience rural life in her native Senegal. Thanks to the partnership between UGB and OSU, Aby along with 83 of her classmates, participated in the first student internship program at UGB. Aby is a student in the newly established Agronomy and Crop Production Program at UGB, made possible in part by funding from USAID/HED. The UGB faculty and administration in the new Department of Agricultural Sciences, Aquaculture, and Food Technologies recognized early on the importance of hands-on learning experiences and training for students studying food production. "Because so many of our students grew up in Dakar, we realized that it would be a disservice to them and to the community not to have a practical component to their education where they can actually implement the techniques they are learning in class," said Dr. Mateugue Diack, Professor in Agronomy at OSU.

Many of the students have spent most of their lives in Dakar, a sprawling city of about 3 million people. After learning theory in the classroom, the students were sent to the villages to apply what they had learned. They were dropped off in groups of 3-4 per village early in the morning. They then walked from the main road, using their cell phones for navigation, sometimes up to 10 km, to the farm where they worked until sundown. They spent the whole day working alongside the farmers and their families. They were even able to share with the farmers what they had learned in the classroom. "It was so exciting being out in the field with the farmers, and to actually do what we had been learning about in class. It was fun to meet the farmers' children, and to share in their work," said Aby.

The program lasted for three weeks, with students in the field on Wednesdays and Saturdays. The farmers, who were at first reticent to have the students on their farms, reported that it was a great experience for them, and not only do they want the students to come again, but they said they would also send their own children to UGB for training.

"I am so impressed with the students who worked on my farm. They were ready to learn, and they were hard workers. I look forward to having UGB students work with me again soon," said Omar Gueye, a local farmer from Tilene.

The internships will continue with each new group of students, two times per year. The program will ultimately contribute to a future Senegal with a more educated agricultural workforce, and an agricultural industry that is productive and sustainable.

Hands-on Agronomy Education Nurtures Senegalese Farming Future

The people of Northern Senegal are poised to begin growing more of their own food, reducing reliance on imports, thus creating a more sustainable future based on self-reliance. An irrigation project by the World Bank created 1,400 hectares of newly irrigated land to be farmed by 243 farmers on small two- to five-hectares plots. However, the availability of irrigated land solves only part of the problem. New farmers need a lot of technical and practical assistance to make sustainable agriculture a reality in Northern Senegal. A higher education partnership funded by the U.S. Agency for International Development through Higher Education for Development is providing the necessary training to farmers for long-lasting results.

Mr. Bergefurd demonstrating the mechanical transplanter to farmers in Northern Senegal (Senegal 2012)

The partners, the Ohio State University (OSU) and Université Gaston Berger (UGB), are creating new degree programs in agro-ecology and crop production. Their activities include implementing a pilot extension and outreach program with the farmers working the newly irrigated land, troubleshooting problems, and conducting farm research on site. An immediate problem the farmers face is the amount of time it takes to plant up to five hectares plots of land, which are much larger than typical Senegalese farms. A farmer is able to transplant 15 plants per minute and about 9,880 tomato plants are needed for one hectare. "I have concern about being able to transplant the plants when they are ready before the rains come," said Aliou Fall, a farmer.

Brad Bergefurd, OSU extension specialist, immediately understood the challenge and recommended the farmer use a mechanical transplanter. The inexpensive device can plant 50 plants per minute, dramatically reducing the amount of time needed to fill a field. With a solution available, education was the next step. The partners purchased a transplanter and held a demonstration and training on December 2012 at the UGB student farm. Recognizing the tremendous impact this technology can have on the future of Senegal, representatives from the media, farmers associations and UGB, as well as politicians, 113 local farmers and 144 students were in attendance.

The learning opportunity created by the partnership left an impression on the attendees. "Not only is it fast, but the rows are perfectly straight, I hope to someday use a transplanter in my fields," said El Hardj Dia, a farmer.

Local farming organizations are planning to purchase additional transplanters, and eventually establish a local transplanter dealer in the Saint-Louis region. Mateugue Diack, partnership director and faculty

member at UGB, considers the wider impact of the training and opportunity for sustainability. “This simple machine has the potential to transform farming not only in Senegal, but across West Africa, enabling Africa to rely less on imports, and increase our ability to export Senegalese produce to Europe,” he said.

Université Gaston Berger (UGB) Faculty of Agricultural Sciences, Aquaculture, and Food Technology Inaugural Graduation of Agroecology Associate Degree Program

Inaugural Graduation of Agro-ecology Associate Degree Program at UGB (Senegal 2014)

On a cool Saturday in March the first class of Associate Degree students crossed the stage at the Université Gaston Berger to receive their diploma in Agro-ecology. The ceremony marking this premiere event pulled out all the stops with a Catholic Choir and brass band accompaniment, and everyone wearing their Sunday best to mark the momentous occasion.

Two years ago the Faculty of Agricultural Sciences, Aquaculture, and Food Technology was created at UGB to provide a hands-on technical Agro-ecology Associate Degree program as well as a Bachelor of Sciences program. At that time thirteen young faculty members were hired to provide instruction, conduct research, and for the first time from an institution of higher education in Africa, provide extension services to local farmers. A higher education partnership between the UGB and The Ohio State University (OSU), funded by the U.S. Agency for International Development through Higher Education for Development, enabled OSU to provide capacity building for the young faculty, resources to update their laboratories, and extensive training in providing university-led extension services to local producers.

OSU Project Director, Dr. Dick and UGB Director Dr. Diack at Inaugural Graduation (Senegal 2014)

On that day in March, 66 students graduated 21of whom were women. These students are now poised to take jobs in local agribusinesses, government agencies, and NGOs.

“Thanks to the hands-on training I received at UGB, I was hired at the Great Domaines of Senegal (GDS) as a quality control specialist for cherry tomato production,” said Ndeyma Fall.

OSU Project Director, Richard Dick, presented UGB with a plaque commemorating the partnership and work that culminated in the two outstanding degree programs.

“This day represents a true milestone, and we were privileged to be a partner from the very first planning of the agriculture programs that now exist at UGB.

We have had many OSU faculty visit UGB and most of the UGB agricultural faculty members have come to The Ohio State University. All of us at OSU have gained so much in terms of academics, research, and Senegalese culture because of the interactions with UGB faculty. The hospitality and friendship has been truly amazing. A special thanks to the UGB Agricultural faculty. Dr. Mateugue Diack and the Faculty through these degree programs will produce many bright graduates, like the ones here today, in the future." Dr. Richard Dick, OSU Project Director.

5. Appendices

Appendix A: University of Gaston Berger/The Ohio State University Final Report

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University of Gaston Berger and Ohio State University titled
"*Development of agronomy and crop production academic programs, research, and need based extension programs for sustainable food production in Senegal*"

December 1, 2010 – June 30, 2015

PARTNERSHIP OVERVIEW

Partner Institutions:

The Ohio State University: University of Gaston Berger

Region:

Sub-Saharan Africa

Dates:

December 2010 to June 2015

Funding Level:

$1,555,877

Leveraged Funds:

$2,568,561

Proposed Cost Share:

$226,885

Partnership Context and Objectives

Purpose
To develop integrated academic, research, and extension service agronomy and crop production programs focused on sustainable food production in the Sahel at the University of Gaston Berger.

Overview
The UGB-OSU partnership provided long-term professional capacity to solve agricultural management challenges in the fragile Northern Senegal and Sahelian ecosystems, and developed premier and innovative agronomy and crop production degree programs at the University of Gaston Berger (UGB), St. Louis, Senegal. The graduates from the program are trained to meet the ecological and agricultural challenges of this fragile, semi-arid environment and provide the human capacity to serve the emerging food export industry in the St. Louis region.

The partnership was funded by a grant from the United States Agency for International Development as part of the Higher Education for Development program.

Background
The Sahel continues to experience severe environmental degradation due to growing rural populations and intensification of agriculture; significantly affecting economic and food security in the region. At the same time Northern Senegal has an emerging irrigated vegetable and fruit export industry. As a result, agribusinesses are moving into the region and export companies are seeking fruit, floral, and vegetable farmers to increase production. It is critical that this industry develops ecologically sound practices because improper irrigation and intensive management can cause salinity and permanently degrade these fragile soils. A trained workforce on food safety, agronomy, horticulture, irrigation, and agribusiness was severely lacking. To meet these challenges trained agricultural professionals, practitioners, and scientists are needed. Before the Agro-ecology Programs at UGB, agricultural higher education in Senegal and the Sahel was fragmented and not meeting these demands.

Partnership Objectives

Objective 1: Implement Associate and B.S. degrees programs in agronomy and crop production at the UGB that supports the emerging food export industry and to meet ecological and agricultural challenges of the fragile and semi-arid environment of Senegal.

Objective 2: To improve human capacity at UGB in the Department of Agricultural Sciences, Aquaculture, and Food Technology.

Objective 3: Provide effective applied research and extension service through a pilot integrated research and outreach program.

Objective 4: Strengthen the newly established departments of the College of Agriculture, Aquaculture and Food Technology at UGB through improved laboratory and teaching supplies.

Activities Summary
During the first year of the partnership the Agroecology Associate and Bachelor of Agronomy degree programs' curriculum were finalized, incorporating hands-on training requirements. Student recruitment and implementation soon followed. To date 149 students (47 women) have graduated from the two programs with 22 of the first Associate degree graduating class continuing on to receive their Bachelor degree this year. Every graduate has completed at least one internship experience with local farmers, agri-businesses, NGO's, and local and national research and extension institutions. Eighteen short-term study tours took place at OSU where each of the UGB faculty was assigned an OSU professor mentor in their discipline. UGB faculty members came to OSU for up to two months to receive training in extension, student-centered teaching, and to work on developing collaborative research between the two universities. Several in-country short-term trainings took place over the course of the project covering topics including: the land-grant university model, how to incorporate a practicum into degree programs, agricultural extension and methods for marketing local produce, teaching weed ecology through field exercises, possibility of a food industries center at UGB, potential for polyculture and tunnel systems for small farmers in Senegal, and piloting and extension of the mechanical transplanter technology. One PhD student, Lamine Diop, was trained at OSU in Agricultural Engineering. Two laboratories were upgraded with teaching and research supplies, including two high-powered microscopes.

Impact on host-country development and prospects for sustainability
Partnership activities strengthened the capacity of UGB faculty to produce winning research proposals, journal articles for peer-reviewed scientific journals, student-centered teaching that inspires inquiry and discussion, and to implement the principles of university-based extension work with farmers. Moving forward Senegal will have a highly trained workforce capable of handling the challenges of food safety, agronomy, horticulture, irrigation in an environmentally sustainable way thus increasing food security and prosperity in the face of a changing climate.

PARTNERSHIP RESULTS

Key Achievements

Implement Associate and B.S. degrees programs in agronomy and crop production at UGB that supports the emerging food export industry and meets ecological and agricultural challenges of the fragile and semi-arid environment of Senegal.

Curriculum Development
During the first year of the partnership, the OSU Strategic Management Team, in collaboration with the faculty and administrators of the newly formed Department of Agriculture, Aquaculture, and Food Science Technology, worked to create and conduct a baseline assessment of the current training at UGB and the needs of the university and region it serves as a whole. There were several curriculum development meetings at both UGB and OSU. While at UGB administrators and faculty presented the OSU land-grant model curriculum and provided feedback for

developing the new UGB curriculum. The result is two cutting-edge degree programs that incorporate the principles of agroecology and hands-on training, both of which are unique to West Africa. The approach aims to improve agricultural production while ensuring sustainability for future generations. The innovative programs also put an emphasis on the link between the producer and consumer paying special attention to socio-economic interactions between rural and urban communities, as well as consumer health which depends on quality products. The Consent Decree authorizing the two programs was signed by the Minister of Higher Education in Senegal in early 2011.

Improve human capacity at UGB in the Department of Agricultural Sciences, Aquaculture, and Food Technology

Faculty Mentoring Program

Fifteen UGB faculty completed 18 study tours at OSU (3 did two tours) where they were paired with an OSU faculty member in their discipline. All of the tours included the same elements which were training in student-centered teaching, lab management, sharing research interests with mentor and OSU community for possible collaboration, training at the University Center for the Advancement of Teaching (UCAT), meetings with extension educator, Scott Scheer, to discuss the basics of delivering an extension program, meetings with Florian Diekman, Agricultural Sciences Librarian, who provided an overview of the resources available at OSU. Each faculty member was provided a guest login account at OSU where they have access to all OSU resources for two years. Also included were visits to OSU South Centers and the Ohio Agricultural Research and Development Center, both field trips provided an opportunity for the UGB faculty to observe on-farm research and extension work with local clientele.

Based on faculty areas of specialty and needs, individualized trainings were provided. Below is a table of the UGB-OSU faculty mentoring teams that resulted in supplemental activities including any specialized training received, published journal articles, and joint proposals submitted. For a complete list of faculty/mentor teams see Appendix A.

Table 1: Supplemental Faculty Mentoring Program Activities and Accomplishments

UGB Faculty Member	OSU Mentor	Supplemental Training	Joint Publications	Joint Research Proposals
Amadou Bocar Bal-Entomology/pest management	Celeste Welty Associate Professor, Entomology	-Extension training for vegetable growers; -Training in the entomology lab in Wooster		
Ngone Beye-Food Science	Monica Giutsi Associate Professor, Food Science and Technology	-Anthocyanisins isolation -Hazard Analysis and Critical Control Points (HACCP) certified by the accredited international HACCP Alliance		
Mariama Dalanda Diallo-Soil science	Richard Dick Professor Soil Microbial Ecology	-Phospholipid fatty acids (PLFA) extraction methods	Diallo, M., Guiesse A., Sall S., Dick R., Assigbetse K., Dieng A., Chotte, J.L. "Influence of tropical leaf litter on niterogen mineralization and community structure	

			of ammonia-oxidizing bacteria." Biotechnol. Agro. Soc. Environ. 2015 19(2), 145-155.	
Michel Diop-Food Science	Ahmed Youseff/ Valente Alvarez Director Food Industries Center	-Hazard Analysis and Critical Control Points (HACCP) certified by the accredited international HACCP Alliance -Individualized 3 week training in dairy processing	Diop, MB. Destain J., Alvarez VB., Konte MA., and Thonart P. "Use of Nisin-Producing Starter Cultures of *Lactococcus lactis subsp. Lactis* on Cereal Based-Matris to Optimize Preservative Factors over Fish Fermentation at 30ºC Typical to Senegal." J Food Process Technol 2015, 6-4.	Development of a pilot research and test center to boost food processing in Senegal Submitted to Bill and Melinda Gates Foundation, September 30, 2013 – not funded
Papa Sher Diop-Animal Science	Stephen Boyles Professor Animal Science	-training in Animal Care Inspection		
Moussa Ndong-Food Science/microbiology	Jlyoung Lee Associate Professor Environmental Health Sciences	-ServSafe® Certificate training in industry strandards for food safety		
Saidou Sall-Soil Science	Richard Dick Professor Soil Microbial Ecology	-enzyme assay analysis	"Microbial Response to Salinity Stress in a Tropical Sandy Soil Amended with Native Shrub Residues or Inorganic Fertilizer." 2015 Journal of Environmental Management. *In press*.	Use of Local Shrub, *Piliostigma reticulatum* in Combination with Arbuscular Mycorrhizal Fungi to Control Plant-Parasitic Nematodes in Vegetables Grown in the Senegal River Valley Ekhagastiftelsen Foundation ($150,000)-pending - System of Rice Intensification (SRI) for smallholder farmers in the River Valley of Senegal: an Ecological Intensification of rice production in response to global warming Submitted to Bill and Melinda Gates Foundation, September 30, 2013 – not funded
Amy Sougou-Administrative	Amanda Davey Program Manager	-Individualized English training (25 hrs.) -Business Administration -Project Management		
Racine Samba Sow-Animal Science	Mike Davis Professor Animal Sciences	Attended the American Dairy Science Association-American Society of Animal Sciences 2013 joint annual meeting in Indianapolis -Visited the Caldwell Cattle Research Station		
Mariama Sene Wade-Animal Science	Rebecca Garabed Assistant Professor Veterinary Medicine	-Toured the cattle livestock auction		

Faculty Development Workshops (In-Country Short-Term Trainings)
As part of the UGB faculty capacity building objective, the Partnership put on a workshop series that covered topics identified by UGB as high priority. Over the course of the project, the Partnership conducted 7 workshops lasting from a half-day to three days, and reaching about 250 participants.

Integrating Extension into Teaching and Research at UGB (February, 2011)
The Partnership coordinated a workshop entitled "Integrating Extension into Teaching and Research at UGB." OSU Director of International Programs in Agriculture, Mark Erbaugh, Associate Director of Extension, Ken Martin, Professor of Agricultural Extension Education, Robert Birkehholz and Project Director, Richard Dick presented interactive training with UGB faculty providing an overview of the U.S. land-grant model, extension and outreach and creating an extension plan of work as well as strategic planning with the faculty to help them vision their extension program and to develop preliminary plans and program activities. In addition, Dr. Dick met with each of the faculty individually to determine linkages between OSU faculty and to plan for the upcoming study tours at OSU. Fifteen faculty attended the four day Workshop.

Strategic Planning for Implementing Participatory Research with Targeted Farmers in the Senegal River Valley and Incorporating Hands-on Learning in Agricultural Degree Programs (November, 2011)
The Workshop objectives were two-fold. The first included presentations from Richard Dick and OSU Extension Specialist, Brad Bergefurd on delivering participatory research and extension programs and extension services provided at universities in the U.S. Partners from the national extension service, Green Senegal, and national research service met to develop a plan for the participatory research and extension program. The second objective was training on providing hands-on training for students as an integral part of the curriculum. Steve Neal, Director of OSU Agricultural Technical Institute (ATI), gave an overview of the ATI curriculum at OSU and training on considerations for using the on-campus research farm for instructional laboratories to enhance academic programs. The Workshop reached 15 faculty and 23 farmers.

Teaching Weed Ecology through Field Exercise (June, 2012)
OSU Weed Scientist, Emmy Regnier, provided a workshop for UGB faculty and students on how to use field exercises for teaching. First she presented to 21 UGB faculty and staff "How to Teach Weed Ecology Using Field Exercises." Then she conducted a Weed Ecology Field Exercise with 23 students enrolled in the Agronomy program. The Exercise corresponded with the students' current course work relating to weed management and provided a hands-on demonstration not only to the students, but also the UGB faculty.

Cultivating Tomatoes in Sub-Saharan Africa (December, 2012)
The Workshop was for UGB faculty with 20 in attendance. OSU Professor, Joe Kovach presented polyculture and greenhouse cropping techniques. Mark Erbaugh, OSU Director of International Programs in Agriculture, presented "Controlling Tomato Blight: Lessons from Tanzania." Brad Bergefurd, OSU Extension Specialist provided training and demonstration on how to use the mechanical transplanter for vegetable production. The mechanical transplanter which allows quicker, more accurate transplantation of seedlings with a lot less labor is a

relatively simple technology that has the potential to transform the way farmers grow their crops in Northern Senegal. The Workshop culminated in a large demonstration to area farmers, students, and local agency officials (88 participants). Additionally, the visit provided an opportunity for the OSU faculty to visit the farmers' plots where the participatory research program is taking place.

Project Management Training (March, 2013)
Project Coordinator, Amanda Davey spent three days training UGB Project Coordinator Amy Sougoua in project management, monitoring, and reporting.

Mechanical Transplanter Extension Program Feasibility and Produce Auction Workshop (July, 2013)
Richard Dick and OSU Extension Specialist, Brad Bergefurd, traveled to Senegal to assist in the design and development of modifications on the mechanical transplanter so that it can be pulled by horses as well as a tractor. Malick NDIAYE of AGRICTECH Co., a private agricultural fabrication and implements company in St.-Louis, helped with the supplies and adaptation of the transplanter. The transplanter was successfully upgraded and is now able to be pulled by horses. The transplanter will be used in an extension program with targeted farmers to mechanize the labor intensive and expensive transplanting process in the face of increased acreage being created in the region for irrigated vegetable production by the World Bank.

The second objective of the Workshop was to train participants (24) including farmers, buyers, agency representatives, and UGB faculty and students on how to conduct a successful produce auction. Participants were given a French translated Buyer/Seller Guide. Mr. Bergefurd gave a PowerPoint presentation explaining the auction process, then showed a video of a produce auction held by the Amish in Ohio. The participants easily understood, and a lively discussion ensued around the idea of using an auction to buy and sell produce in Senegal, a process which would ensure fair market value to producers.

Brown Bag Seminar Series (June 2015)
OSU Professors, Richard Dick, Larry Brown, and Konrad Dabrowski traveled to Senegal for Dr. Brown to assist Ph.D. candidate Lamine Diop in developing his in-country research, and for Dr. Dabrowski to investigate potential aquaculture research opportunities with UGB Faculty members, Farokh Niasse and Mohamadou Ly. While there the Professor's each presented a seminar for UGB Faculty and students, entitled "Rhizosphere hydrology and microbiology of shrub-intercropping: A system to resist drought stress and optimize yields of dryland farming in the Sahel," Dr. Dick, "Agricultural Drainage in the Midwest USA: Use and Management for Water Quantity and Quality," Dr. Brown, and "Research goals in improvement of major aquaculture limitation: replacement of fish meal with plant protein sources in aquafeed utilization," Dr. Dabrowski. The seminars reached forty-eight participants.

<u>PhD Training</u>
To fill the knowledge gap that currently exists at UGB with regards to irrigation, Mr. Lamine Diop, received PhD training at OSU in Agricultural Engineering under Advisor, Dr. Larry Brown. After successfully completing one semester of English Language Training he enrolled in the PhD program in the College of Food Agriculture and Environmental Science. He passed his

candidacy exam on June 12, 2015 after earning a 3.9GPA in two years of course work at OSU. He has returned to Senegal where he is conducting his research and will return to OSU for one semester to defend his dissertation in December 2017.

Provide effective applied research and extension service through a pilot integrated research and outreach program

Baseline Survey and Report of Targeted Farmers at PDMAS

The Program of Development of Agricultural Markets and Food of Senegal (PDMAS) was implemented in April 2007 with the support of the Government of Senegal, the World Bank, and the Canadian Agency for International Development (CIDA). The primary objectives of PDMAS are to strengthen and develop value added, supply chains of agricultural and livestock sectors with significant commercial potential.

The central project of PDMAS is an irrigation system for 2500 hectares of land in the Senegal River Basin which is located in the villages of Ndialir Gueye, Gandiaye, Diagambal, Massara Goabou, and Polo. The project sites have been built with the necessary canals and water distribution system to provide year-round cropping and engineered for high water use efficiency by using drip irrigation technology. The site has been divided into three farm categories: two ha farms, 20 ha farms, and 100 ha farms. Two hundred and forty-five farmers have been selected for the 2 ha farms. A multi-disciplinary research and training program was needed for these farmers that can address all the agronomic and water management challenges of the PDMAS project. Through this Project a focused UGB pilot program of Participatory Research and Extension that works to help the farmers develop and manage the 2500 ha of irrigated land was established.

During the first year of the Project, NGO Green Senegal, worked with UGB Faculty to conduct an assessment of the strengths and weaknesses of the agricultural production techniques of producers in the three targeted villages of Pont Gendarme, Gandiaye, and Ndialakhar. The report titled, "Characterization and Types of Farms of Villages Gendarme Bridge, Gandiaye, and Ndialakhar," provided the initial starting point for the new extension program activities.

Strategic Planning for UGB Participatory Research and Extension Program (November, 2011)

Twenty-six farmers took part in a one day participatory workshop and planning meeting with seven UGB Faculty members, four OSU Faculty members, and representatives from Green Senegal, Farmers Cooperative, and Senegal Extension Agency (SAED). Farmers requested training in all aspects of production including: growing, financial management, technology, sustainable agriculture practices, irrigation maintenance, forage production, and post-harvest processing. The meeting highlighted for members of the new Program the great amount of information and needs the farmers are requesting and the immense importance of the extension component of their University mission.

Salinity as a Limiting Factor in Peanut Production and Tomato and Onion Production Training (April and May, 2012)

In April 2012, 22 young, peanut farmers in the targeted PDMAS region were visited by UGB faculty to monitor their crop production. Symptoms of salt affected crops were quite visible.

From farmer input, it was decided that a training session was needed for the farmers to explain to them what caused the slow peanut growth and the possible loss in terms of yield and actions that can be taken to improve yields. Another extension activity took place on May 17, 2012. Farmers organized into six associations requested assistance with their tomato and onion production, which did not go well the past dry and cool growing season. The crop yields recorded were relatively low. This raised a number of issues regarding seeds, and the need to know the requirements for the hybrid tomato seeds in order to get high yields. Another issue was a lack of knowledge about how to prevent disease and insect attacks also on tomato plants. Last, there were questions about availability of common fertilizers and the rates of application. These issues are critical because with good tomato production the farmers can make much greater profits at the end of the cropping season with tomatoes rather than onions. With regards to onion production, because the price of onions is lower than tomatoes, the farmers are looking for ways to reduce their onion production costs. The UGB faculty worked to help the farmers reduce their labor costs by mechanizing parts of the production process. Another issue raised was if the price at the market was not good enough, how best they could store their harvested product in order to wait for a better price.

Pest Management System (October, 2012)

Nineteen students from the Bachelor Program conducted a crop survey on 15 farmers' fields in two villages, Pont Gendarme and Ndialakhar. The survey collected information on tomato and onion insects and diseases, and crop protection practices. Lessons learned from the survey include:

-Onion crops have less entomological problems than tomato crops in these two locations. However, at Pont Gendarme, a larva of Lepidoptera was reported feeding on the leaves. A follow-up survey will include evaluation of this larva;

-Damage on tomato plants was reported, but the most important issue besides Helicoverpa armigera on fruits is a disease for which one variety seems to be more susceptible. Symptoms of this disease are leaf necrosis, plant wilting and death;

-Pesticide application by farmers at Pont Gendarme is based on calendar, without any insect or disease observation. So the proper application techniques need to be determine; and

-Wrong applications of pesticides and their disposal were noticed with some farmers.

Insect traps were placed in farmers' fields and collected by students every week for three weeks. This is the beginning of the development of an Integrated Pest Management System. The traps will indicate what insects there are at a given time indicating to the farmer when pesticide treatment is needed. The students are working to determine the best way of collecting the traps and bringing them back to the lab for insect counts, and which insects should be monitored for each crop.

<u>Pilot Mechanical Transplanter Extension Program</u>

While visiting Ohio several UGB Faculty and the UGB Rector, Mary Teuw visited Amish farmers in Southern Ohio. The Amish do not use electricity or modern conveniences and are very successful farmers and business people. The Senegalese were able to easily relate to their situation and were fascinated by their ingenuity and many of the minor farm implements used to mechanize their production systems. In particular, they were very interested in a simple machine the Amish used to transplant seedlings called a mechanical transplanter. They immediately recognized the ability of this inexpensive machine to greatly reduce their labor costs, which is the most expensive and time-consuming aspect of their vegetable production and also that the

machine would enable a smallholder farmer to bring more hectares under cultivation. They requested that we work with them to bring the transplanter technology to Senegal and work with the farmers on a pilot extension program.

- Once the transplanter arrived in Senegal, in December 2012 the first training and demonstration took place. Brad Bergefurd, OSU Extension Specialist provided training and demonstration on how to use the mechanical transplanter for vegetable production. The Workshop culminated in a large demonstration to area farmers, students, and local agency officials, and news media (88 participants).
- July 2012 Richard Dick and OSU Extension Specialist, Brad Bergefurd, traveled to Senegal to assist in the design and development of modifications on the mechanical transplanter so that it can be pulled by horses as well as a tractor. Malick NDIAYE of AGRICTECH Co., a private agricultural fabrication and implements company in St.-Louis, helped with the supplies and adaptation of the transplanter. Mr. NDIAYE has expressed a desire to import the transplanters for sale in his shop. The transplanter was successfully upgraded and is now able to be pulled by horses.
- Summer 2014, Planning took place all summer to set-up a trial of the mechanical transplanter for farmers in September and then again in March, 2015. Members of the planning team included Madiama Papa Diop of the Institut Senegalais de recherches agricole (ISRA), business owner, Malick Ndiaye of GIE Agritech, along with UGB partnership Co-PI Mateugue Diack, OSU Extension Specialist, Brad Bergefurd, Richard Dick, and Amanda Davey.
- September 2014, Richard Dick and Brad Bergefurd in conjunction with the Senegal Transplanter Team put on a 4 day workshop and demonstration of the transplanter. Mr. Bergefurd led a presentation and discussion of the transplanter to UGB Faculty and students culminating in a transplanter trial with animal traction at the UGB Research Farm. Troubleshooting and adaptation of the transplanter at the UGB Farm took place. The transplanter was successfully piloted with twelve PDMAS farmers. At the end of the workshop evaluation of the machine and recommendations were recorded. It was agreed that a separate transplanter for onion production would be needed because onions and tomatoes have different spacing and row requirements.
- Winter 2015 carts and other adjustments were built for the transplanters by Team members in Senegal. An onion transplanter was purchased and shipped to UGB.
- Trials with onions and tomatoes are currently underway with PDMAS farmers.

Strengthen the newly established departments of the College of Agriculture, Aquaculture and Food Technology at UGB through improved laboratory and teaching supplies

During the year one baseline assessment it was determined that faculty were lacking basic supplies to begin their hands-on teaching and research programs. A supplies purchasing program was developed where each of the fourteen faculty were given $4,000 to buy basic teaching and research supplies. Several of the members pooled their resources and purchased two high-powered light microscopes. A total of $56,000 was spent updating two laboratories with glassware, chemicals, and basic equipment.

Development Outcomes/Significant Impacts

Partnership activities strengthened the capacity to address Senegal's Millennium Development Goal 1 (MDG) to halve extreme poverty and hunger by 2015. With agriculture playing a major role in the economy > 60%, the projects activities to create a trained labor force with the expertise to increase yields while conserving resources, has an immediate and long-term impact on improving the outlook for self-sufficiency and food security in Senegal. Also through this workforce development the project's impact will continue to address Senegal's food insecurity in keeping with the goals outlined in the 2008 Grand Offensive for Food and Abundance.

Through the projects capacity building activities involving short-term trainings and study tours for UGB Faculty, the institutional capacity of UGB was enhanced and will continue to be a beacon for sustainable food production in Senegal as well as a source for information and cooperation with local farmers, national research and extension agencies, and agribusinesses. In effect changing the role of the university from one of isolation to an active partner in the community solving development problems and transferring knowledge to where it is needed – on farm.

Significant Implementation Challenges

Uncertain Funding and Budget Approval Delays

Beginning six months after the signing of the subaward agreement with HED threats of reduced funding began. There was no allowance or grace period to negotiate subawards and begin the wire transfer process, demonstrating a lack of understanding of how institutions of higher education, especially at the international level, work. Even after spending picked up and was on-target the threat that we might not receive the remainder of Phase I or any of Phase II funding continued. Open meetings with USAID/HED representatives took place in year two of the project. Because of the openness of these meetings the UGB faculty, staff, and students were made aware of the funding challenges. The effect of this threat had many consequences that trickled down into all aspects of the project. For example, prior to this UGB had signed on two new PhD student/Professors that were to be trained at OSU in Agricultural Engineering and Weed Science, taking note of the uncertain funding future, one of the highly sought after PhD students backed out of the program. Losing her was a major blow to UGB and the project, particularly because it is so difficult to find qualified women for agricultural academic positions in Senegal. The news of the end of funding had a crippling effect on project planning and spending. Once partners were notified that indeed we would receive the rest of Phase I and part of Phase II funding activities were able to resume with minimal damage done to the project's credibility at UGB.

The final budget approval for FY15 took over three months with countless back and forth with an HED Accountant. This unnecessary delay resulted in an important component of the Transplanter Extension Program not being accomplished before the project deadline.

Complex Reporting Software

Because of the complexity of the PRIME software, our Senegalese partners, were not able to input their own data and information which resulted in underreporting of important activities.

Being geographically removed is a universal problem with international projects. With a less complex reporting system, the project partners on the ground would be able to give input.

UGB Faculty member unable to engage in U.S. long-term training
After two semesters studying English Mr. Cesar Bassene's TOEFL and GRE scores were still too low to be admitted to Ohio State. Mr. Bassene was scheduled to attend UF under the direction of Dr. Carlene Chase, an expert in tropical weed ecology, to continue work on developing collaborative research in weed science. After several weeks of trying to reach Mr. Bassene it became clear that he did not want to come to the U.S. to work with Dr. Chase. The partners are still unclear about what caused this dramatic change because Mr. Bassene had expressed his continued desire to work with Dr. Chase. Although the partnership expended a lot of time and effort during the process of working with Mr. Bassene, no money from the partnership budget was lost. Wanting to provide an equal type of programming, the partnership decided to spend the resources on two new UGB Faculty members who have their Master's Degree and would benefit greatly from training at Ohio State with mentor professors. With Mission approval, Ngone Beye mentored with Dr. Monica Giutsi in Food Science, and Ly Mohamadou mentored with Dr. Konrad Dabrowski in Aquaculture. These additional trainings and the development of collaborative research provided the foundation for Mr. Lyand Ms. Beye to begin their PhD training.

CONCLUSION

Key Lessons Learned

Communication
Frequent and effective communication between all partners was required for success of the Partnership. This included open lines of communication with all of the UGB Agricultural Sciences, Aquaculture, and Food Technology Department Faculty. The adoption of a rotating administrative team among the UGB Facutly fostered universal understanding of the project activities and lent buy-in of the entire Department for the OSU Study Tours, in-country short-term training, and extension activities. This greatly contributed to the success of the project and ease for OSU Project Director and Staff working with UGB. We credit our UGB Co-PI, Dr. Mateugue Diack, for implementing the rotating administrative team, and applaud his inclusive leadership style.

Importance of Flexibility and Strong Leadership
Remaining flexible is of primary importance for Partnership success when faced with unexpected challenges. There were several instances throughout the project that required adjustments in activities. Having strong project leadership allowed for quick decision-making and changes in plans that resulted in alternative activities to the benefit of our UGB partners. For Example, when Phase II funding was dramatically reduced, most of the extension activities were unable to continue. With limited funds available project leaders decided to focus the extension program on training and outreach with the mechanical transplanter. Another example was the capacity to quickly add two study tours when the training for Mr. Bassene was cancelled. The ability to take advantage of unexpected opportunities and transform them into beneficial outcomes is the hallmark of flexible thinking and an essential quality in international development.

Importance of Time for Making Lasting Changes

An important lesson we hope to pass on to future Higher Education Partnerships is that in order to achieve lasting impacts that result in institutional changes and paradigm shifts, a minimum of five years is required. The complexity of working not only with institutions of higher education, but internationally as well, requires more time than other types of projects. For example, we worked hard to export the U.S. land-grant university model of teaching, research, and extension. For most of the UGB faculty, this was a new concept and they worked hard to incorporate the additional extension component into their workloads. Meanwhile project partners worked with UGB university leadership to institutionalize including extension in university paradigm through the creation of a UGB Research and Development Center. Project partners were making progress in this regard with proposals before the UGB Rector and Senegal Ministry of Higher Education. Unfortunately when project funding was cut in year two the momentum for institutional change was lost. The effectiveness of USAID dollars spent on higher education projects working to make institutional changes would have greater success with a five year minimum duration.

Future Collaboration and Opportunities

The Partnership between OSU and UGB will continue to develop and grow. On March 5, 2013 an Extension of the Memorandum of Agreement between the universities was signed guaranteeing collaboration through July 22, 2018. Several of the Mentoring Teams are committed to research collaborations including the Director of the OSU Food Industries Center, Valente Alvarez and Dr. Michel Diop who are currently developing a business plan for the UGB pilot food industries center to achieve financial sustainability. Other synergies include five faculty mentor teams committed to developing joint research proposals and two UGB faculty plan to return to OSU to continue research and collaboration with their OSU mentor.

The mechanical transplanter extension program will continue with plans for OSU Extension Specialist, Brad Bergefurd, to return to UGB in September for training and demonstrations.

Dr. Larry Brown will continue to work with PhD candidate Lamine Diop until his graduation in December of 2017.

APPENDICIES

Appendix A OSU-UGB Faculty Mentor Teams

UGB Faculty Member	OSU Mentor
Amadou Bocar Bal- Entomology/pest management	Celeste Welty Associate Professor, Entomology
Ngone Beye- Food Science	Monica Giutsi Associate Professor, Food Science and Technology
Mantegue Diack- Soil science	Richard Dick Professor Soil Microbial Ecology
Mariama Dalanda Diallo- Soil science	Richard Dick Professor Soil Microbial Ecology
Michel Diop- Food Science	Valente Alvarez Director Food Industries Center
Papa Sher Diop-Animal Science	Stephen Boyles Professor Animal Science
Justin Kantoussan- Aquaculture/ecology	Mazeika Sullivan Associate Professor Ecology
Mouhamadou Ly- Aquaculture	Konrad Dabrowski Professor Aquculture
Anicet Manga- Crop Science	Jim Metzger Professor Crop Science
Moussa Ndong- Food Science/microbiology	Jlyoung Lee Associate Professor Environmental Health Sciences
Farokh Niasse- Aquaculture	Konrad Dabrowski Professor Aquculture
Saidou Sall- Soil Science	Richard Dick Professor Soil Microbial Ecology
Amy Sougou- Administrative	Amanda Davey Program Manager
Racine Samba Sow- Animal Science	Mike Davis Professor Animal Science
Mariama Sene Wade- Animal Science	Rebecca Garabed Assistant Professor Veterinary Medicine

Appendix B Success Stories

Hands-on Agronomy Education Nurtures Senegalese Farming Future

The Ohio State University/Université Gaston Berger

Photo by Richard Dick, The Ohio State University

The Ohio State University Extension Specialist Brad Bergefurd teaches two UGB students where to place the seedlings to be transplanted as hundred more watch the demonstration.

The people of Northern Senegal are poised to begin growing more of their own food, reducing reliance on imports, thus creating a more sustainable future based on self-reliance. An irrigation project by the World Bank created 1,400 hectares of newly irrigated land to be farmed by 243 farmers on small two- to five-hectares plots. However, the availability of irrigated land solves only part of the problem. New farmers need a lot of technical and practical assistance to make sustainable agriculture a reality in Northern Senegal. A higher education partnership funded by the U.S. Agency for International Development through Higher Education for Development is providing the necessary training to farmers for long-lasting results.

The partners, the Ohio State University (OSU) and Université Gaston Berger (UGB), are creating new degree programs in agro-ecology and crop production. Their activities include implementing a pilot extension and outreach program with the farmers working the newly irrigated land, troubleshooting problems, and conducting farm research on site. An immediate problem the farmers face is the amount of time it takes to plant up to five hectares plots of land, which are much larger than typical Senegalese farms. A farmer is able to transplant 15 plants per minute and about 9,880 tomato plants are needed for one hectare. "I have concern about being able to transplant the plants when they are ready before the rains come," said Aliou Fall, a farmer.

Brad Bergefurd, OSU extension specialist, immediately understood the challenge and recommended the farmer use a mechanical transplanter. The inexpensive device can plant 50 plants per minute, dramatically reducing the amount of time needed to fill a field. With a solution available, education was the next step. The partners purchased a transplanter and held a demonstration and training on December 2012 at the UGB student farm. Recognizing the tremendous impact this technology can have on the future of Senegal, representatives from the media, farmers associations and UGB, as well as politicians, 113 local farmers and 144 students were in attendance.

"This simple machine has the potential to transform farming not only in Senegal, but across West Africa."

— Mateugue Diack, partnership director and Université Gaston Berger

The learning opportunity created by the partnership left an impression on the attendees. "Not only is it fast, but the rows are perfectly straight, I hope to someday use a transplanter in my fields," said El Hardj Dia, a farmer.

Local farming organizations are planning to purchase additional transplanters, and eventually establish a local transplanter dealer in the Saint-Louis region.
Mateugue Diack, partnership director and faculty member at UGB, considers the wider impact of the training and opportunity for sustainability.
"This simple machine has the potential to transform farming not only in Senegal, but across West Africa, enabling Africa to rely less on imports, and increase our ability to export Senegalese produce to Europe," he said.

University of Gaston Berger Faculty of Agricultural Sciences, Aquaculture, and Food Technology Inaugural Graduation of Agroecology Associate Degree Program

On a cool Saturday in March the first class of Associate Degree students crossed the stage at the University of Gaston Berger to receive their diploma in Agro-ecology. The ceremony marking this premiere event pulled out all the stops with a Catholic Choir and brass band accompaniment, and everyone wearing their Sunday best to mark the momentous occasion.

Two years ago the Faculty of Agricultural Sciences, Aquaculture, and Food Technology was created at UGB to provide a hands-on technical Agro-ecology Associate Degree program as well as a Bachelor of Sciences program. At that time thirteen young faculty members were hired to provide instruction, conduct research, and for the first time from an institution of higher education in Africa, provide extension services to local farmers. A higher education partnership between the UGB and The Ohio State University (OSU), funded by the U.S. Agency for International Development through Higher Education for Development, enabled OSU to provide capacity building for the young faculty, resources to update their laboratories, and extensive training in providing university-led extension services to local producers.

On that day in March, 66 students graduated 21of whom were women. These students are now poised to take jobs in local agribusinesses, government agencies, and NGO's.

"Thanks to the hands-on training I received at UGB, I was hired at the Great Domaines of Senegal (GDS) as a quality control specialist for cherry tomato production," said Ndeyma Fall

OSU Project Director, Richard Dick, presented UGB with a plaque commemorating the partnership and work that culminated in the two outstanding degree programs.

"This day represents a true milestone, and we were privileged to be a partner from the very first planning of the agriculture programs that now exist at UGB. We have had many OSU faculty visit UGB and most of the UGB agricultural faculty members have come to The Ohio State University. All of us at OSU have gained so much in terms of academics, research, and Senegalese culture because of the interactions with UGB faculty. The hospitality and friendship has been truly amazing. A special thanks to the UGB Agricultural faculty – Dr. Mateugue Diack and the Faculty through these degree programs will produce many bright graduates, like the ones here today, in the future." Dr. Richard Dick, OSU Project Director