



Internationalizing the Land Grant Mission: Lessons from Senegal

Ozzie Abaye, Professor, Teaching/Extension/International Development, Crop and Soil Environmental Sciences, Virginia Tech
Thomas Archibald, Assistant Professor, Extension Specialist, Agricultural, Leadership, and Community Education, Virginia Tech
Larry Vaughan, Director of InnovATE, Office of International Research, Education, and Development (OIREd), Virginia Tech

Thomas Thompson, Associate Dean and Director Global Programs CALS Global, Virginia Tech

Wade Thomason, Professor, Grains Specialist, Crop and Soil Environmental Sciences, Virginia Tech

Demba Farba Mbaye, Chief Party/Project Director, USAID/ERA Project, Virginia Tech, Dakar, Senegal

Mamadou LO, Research and Extension Specialist, Institut Sénégalais de Recherches Agricoles (ISRA), Senegal

Abdoulaye SY, Directeur de Zone, Direction de Zone Bassin Arachidier Sud Agence Nationale de Conseil Agricole et Rural (ANCAR), Senegal

Fatou Gueye, Academic Support Officer in the implementation of curriculum development and e-Learning programs, USAID/ERA Project, Virginia Tech, Dakar, Senegal

Glenda Snyder, Senior Extension Agent Emerita, Virginia Cooperative Extension, International Programs, 4-H Youth Development, Virginia Tech

Bineta Guesse, Gender Coordinator and Outreach USAID/ERA,

International Community Economic Development, Gender and Youth Integration in Community, Virginia Tech, Dakar, Senegal

Kathleen A. Jamison, Extension Specialist, 4-H Youth Development, Virginia Cooperative Extension, Professor Emerita, Virginia Tech

Taylor N. Vashro, Department of Human Nutrition, Foods and Exercise, Virginia Tech

Introduction

Land-grant universities, formed as a result of the Morrill Act of the U.S. Congress in 1862, were established to reach out to the public they serve. Although the Act's initial purpose was to serve local needs, globalization of agriculture and especially of marketing, production, distribution, and consumption necessitated outreach beyond geographic, political, and language barriers. During his inauguration address in 2014, Timothy D. Sands, the president of Virginia Tech, promoted extending the land-grant mission beyond Virginia's borders, saying "... We live now in a world of wide horizons and international landscapes; so, we should also commit ourselves to becoming recognized as a top-100 global research institution. The best talent knows no boundaries. Maintaining impactful, curiosity-driven scholarship requires the best minds on the planet."

The United States Agency for International Development – Education and Research in Agriculture (USAID-ERA) is a five-year project (extended to eight years) within the U.S. Government's Global Hunger and Food Security "Feed the Future" Initiative (www.feedthefuture.gov). The overall goal of the

project is to revitalize the agricultural sector through education, research and discovery, and outreach. To achieve this goal, the project offered a combination of targeted short-term and long-term training programs to individuals or selected groups of participants from its Agriculture Education Training and Research partner institutions. This paper will highlight several agricultural interventions at community, private, and public sector levels using the land-grant model. Some of the agricultural interventions mentioned in the paper focus on those that have the explicit goal of improving food security by inducing multi-level institutional changes. The Feed the Future framework is to create synergies and collaborations between Senegalese and U.S. institutions to tackle the issues of extreme poverty and hunger and improve food security for all people in Senegal.

Solving Problems Using the Land-Grant Model

Senegal is located in the western corner of Africa's Sahel region. Agriculture is the backbone of Senegal's

economy; in fact, the agricultural sector employs 75 percent of Senegal's 14 million people. However, the lack of clear connectivity between discovery, education, and outreach makes it nearly impossible to measure any advancement in the agricultural sector. Thus, despite progress in agricultural development, poverty remains high, affecting 46.7 percent of the population (USAID 2014). Since 2010, USAID-ERA, in collaboration with several Senegalese institutions (both public and private) and Virginia Tech (College of Agriculture and Life Sciences/Virginia Cooperative Extension), has been engaged in outreach, research, and education activities to address critical food security issues. Specific issues addressed have included seed quality control, diversification of cropping systems, grassland management and conservation of fodder in the form of silage for animal feed, and educational programs targeting children and young adults.

The Public-Private Partnership for the Development of Seed Training Programs

In 2014, USAID-ERA, in collaboration with several government and public sector organizations, employed the land-grant model to bring together existing research-based knowledge and introduce new advancements in seed production and quality measures. Seed is one of the most important factors influencing yield potential. The cost of seed (for planting) in general is usually 20 to 25 percent of the total cost of production (Bolton et al. 2009). To identify constraints associated with Senegal's seed sector, USAID-ERA surveyed both public and private seed sectors. The survey revealed that 1) the private sector is loosely linked with the public institution; 2) the seed sector generally lacks trained field and laboratory technicians to aid the seed certification program; and 3) the linkage between farmers who are involved in seed production for both food and seedstock (planting) is minimal to nonexistent.

Based on the needs assessment survey, USAID-ERA in collaboration with Senegalese private and public seed sectors implemented interventions in multiple settings. The overall objective of the three-part training program was to improve food security through the training of agricultural technicians who could provide services to farmers, such as crop variety selection and seed marketing. The 25 trainees were Extension agents with Agence Nationale de Conseil Agricole et Rural (ANCAR), the national Extension agency, and laboratory technicians from public seed sectors and universities. The first part of the training program

focused on basic information about Senegal's seed sectors, including seed law and regulations, as well as basic information on seed production, protection, breeding, and biotechnology. The focus of the second and third parts of the training was on laboratory seed analysis (figs. 1 and 2) and field inspection (fig. 3).



Figure 1. Identification and characterization of peanut varieties



Figure 2. Preparing seeds for a germination test



Figure 3. Seed technician trainees inspecting crops

The laboratory seed analysis component, consisted of grain variety identification, accurate seedlot sampling for seed testing, and seed testing for germination using various methods. In the third part, participants inspected both farmer- and researcher-managed fields for off-type crop varieties, weeds, and diseases, and learned how to estimate yields of standing crops. Following the laboratory and field exercises, the participants visited a government-run seed inspection/certification lab. Here the participants learned the entire seed certification process including seed cleaning, packaging, and labeling.

After completing the three-part training, the participants received an official (USAID/ERA-Virginia Tech) certificate of training. The 25 trained individuals, including technicians, Extension agents, and several junior faculty members, then went back to their localities and trained farmers and farmer organizations involved in seed production and marketing. By October 2015, the technicians had trained 226 seed producers. The land-grant model used in the training program not only resulted in increased human resources in the seed sector but also created the framework for public/private cooperation to build national capacity for Senegal's seed sector. Most importantly, the framework led to institutional change — five higher education institutions and several seed sectors developed master's and bachelor's degree programs focusing on seed science and technology. Curriculum features include an inter-institutional diploma involving several institutions. Overall, the program will produce a bachelor's degree in field and laboratory seed inspection and a master's degree in crop breeding.

Dry Season Feed Supplement: The Role of Silage for Senegal's Smallholder Farmers

Livestock contributes significantly to food supply and nutrition and is a major source of protein, minerals, vitamins, and micronutrients (Reynolds et al. 2015). The major factors limiting productivity from animals (milk, meat, wool, etc.) are the quantity and quality of feed, especially during the dry season. During the rainy season (July-October), forage supply exceeds animal needs. A lack of feed resources is most prevalent during the dry time of the year when the demand for sheep and goats is the highest (October/November). The only practical way to narrow the gap in forage needs between the two distinct seasons is to conserve excess forage produced during the rainy

season. To reduce feed shortages during the extended dry season, USAID-ERA and several agricultural institutions in Senegal along with faculty members from CALS worked with local Extension agents, farmers, and farmer organizations in Senegal. Lack of sufficient drying conditions during the rainy season make hay cutting and drying impossible. On the other hand, silage-making is much less dependent on weather conditions than haymaking. The primary challenge to the widespread use of silage has been the high labor cost associated with the process. Since 2012, hundreds of smallholder farmers have been trained on silage-making (figs. 4 and 5), storage, handling, and feeding. To make the silage-making process less time consuming, small-scale silage production (Cherney et al. 2004) has been introduced by Virginia Tech researchers in Senegal.



Figures 4 and 5. Women from Santanba village collect and chop forage species for silage.

In this project, the silage was made using any vegetation, and fruit that has feed value, such as grasses, non-leguminous weedy forbs, and vegetables. The farmers were taught the importance of understanding the silage-making process, including

the proper cutting length of the forage materials; how to pack and compact, which is a crucial step in completely removing the air and excluding air pockets (ensiling is an anaerobic process); and storage and feeding. As a result of this training, small-scale silage production by smallholder farmers has gained wide acceptance. Providing the training programs has also reinforced linkages between Senegal’s cooperative Extension service (ANCAR) with the Institut Supérieur de Formation Agricole et Rurale (ISFAR), a higher education institution in Senegal.

Introducing Mungbean for Food/Feed/Cover Crop

According to the 2016 Global Nutrition Report, malnutrition of young children in low-income countries may manifest as poor child growth and development, leading to wasting or stunting; micronutrient deficiencies (especially vitamin A, iron and iodide); and overweight or obesity (IFPRI 2016). The repercussions of malnutrition, in all of its forms, permeate every level of a community and nation. Malnutrition experienced by children or adults may cause deleterious effects on their health by impairing cognitive and physical development. These effects may also reduce work capacity and limit human capital, thereby impeding economic growth and progress and fostering dependency on foreign assistance. USAID has identified Senegal as a country suffering with “hidden hunger” as micronutrient deficiencies are extremely high (Benzekri et al. 2015).

In 2010, 63 percent of children in Senegal had a moderate form of anemia, and the prevalence of severe anemia is two to 10 times higher in more rural regions compared to large urban areas such as Dakar and Ziguinchor (Fanzo 2012). In 2012, USAID-ERA, through linkages between research, education, and outreach, began investigating the potential utilization of mung bean as a new crop with a nutrition-led agriculture focus, recognizing that acceptance and consumption of mung bean may simultaneously address malnutrition and food insecurity in Senegal (Scholl 2011). The USAID-ERA initiative was based on the many nutrient, agricultural, and climate-tolerant advantages of using mung bean to address food insecurity and malnutrition in Senegal (figs. 6 and 7). Mung bean is a greater source of protein and fiber when compared to its cultural counterpart, cowpeas, and other staple grains (table 1).








Figure 6. This mung bean farmer, shown in his field, produced 30 kilos (66 lbs.) from 0.5 kilos (1 lb. of mung bean.). Some farmers produced up to 150 kilos (330 lbs.) of mung bean.



Figure 7. Abdoulaye SY, director of ANCAR-Kaolack, joins other Extension representatives and a mung bean farmer.

Table 1. Comparison of nutrient information of white rice, millet, cowpeas, and mung bean (USDA Food Composition Database, 2016)

Food (1 cup)	White Rice (medium grain, unenriched, raw)	Millet (raw)	Cowpeas (raw)	Mung Bean (raw)
				
Kcals	702	756	561	718
Fat (g)	1.13	8.44	2.10	2.38
Carbs (g)	1.54.71	145.70	100.25	129.62
Fiber (g)	.6	17	17.7	33.7
Protein (g)	12.89	22.04	39.28	49.39
Iron (mg)	1.56	6.08	13.81	13.95
Magnesium (mg)	68	228	307	391
Phosphorus (mg)	211	570	708	760
Potassium (mg)	168	390	1857	2579
Folate (mcg)	18	170	1057	1294

Kcals (calories), Carbs (carbohydrates), g (grams), mg (milligrams), mcg (micrograms)



Figure 8. Children enjoy mung beans during a mung bean field day at Kadiel-Bakel, Senegal.

A study was conducted to assess the impact of mung bean on dietary diversity of Senegalese women and children across several regions in Senegal. A mixed-methods research approach was used, including individual surveys to determine dietary diversity scores (DDS) and focus groups to assess the perceived impacts of mung bean. The dietary diversity survey was conducted with 194 participants including adult women, ages 15 to 70 years (n=109), and children, ages 0-10 years (n=85). The results of these surveys revealed that there were higher DDS in mung bean consuming women compared to both mung bean and non-mung bean consuming children. However, there was no difference in dietary diversity overall between mung bean and non-mung bean consuming groups. Still, the women interviewed (n=109) identified benefits from mung bean consumption, including increased breastmilk production, increased energy, reduced risk of anemia, less constipation, less hunger, and improved weight status for children. The focus group included only mung bean consuming women, who indicated they perceived agricultural, health, and financial benefits associated with mung bean consumption (Vashro 2017). These findings provide insight into how to effectively influence public policies and perceptions regarding mung bean production and consumption — by focusing on the potential positive agricultural, health, and financial outcomes.

4-H Senegal

Throughout the world, 4-H often institutionalizes new practices in a community by teaching the youth first. As part of 4-H's journey beginning over 100 years ago, the focus on experiential learning while targeting life skills results in positive youth development. As children and youth grow in confidence and promote what they learn in 4-H, they add to their community's heritage and legacy. A new 4-H program in Senegal exemplifies this process. The children and youth are learning new agricultural practices and are becoming partners with adults in their communities.

In March 2015, USAID-ERA, in collaboration with Virginia Cooperative Extension/4-H, Ecole Nationale Supérieure d'Agriculture (ENSA), ISFAR, local Peace Corps volunteers, Peace Corps/Senegal, Kaolack University, Senegal's Ministry of Higher Education, county representatives and other government officials, launched the 4-H Positive Youth Development program in Senegal. The 10-day program led by Bineta Guisse, Kathleen Jamison, and Tom Archibald included training 25 individuals consisting of community leaders, local and Peace Corps volunteers, faculty from USAID-ERA partner institutions (ENSA and ISFAR), plus ANCAR and government officials. The overall objectives of the training program were to work as a team to set program goals, create programs to help youth develop life skills, and establish a safe and positive learning environment for youth to develop self-efficacy in meeting the needs of the community. The initiation of a 4-H program would be the key to bridge the agricultural sectors in Senegal. Aligning and partnering Senegal's 4-H Youth Development programming with Virginia 4-H provides opportunities for coaching and mentoring with adult volunteers and youth programming (fig. 9). Currently, 4-H Senegal has grown to 34 clubs, over 568 members, and 163 trained/certified leaders.



Figure 9. Bineta Guisse with one of several 4-H clubs in Senegal.

Summary

The research, outreach, and educational programs described in this paper reflect the importance of adapting the land-grant model to link teaching, research, and outreach to tackle food security issues globally. The education and outreach programs show the importance implementing the land-grant model to effect change and bring about human and institutional capacity-building to strengthen and empower the public and private sectors. Direct results of this project include increasing human resources in Senegal's seed sector and bringing together stakeholders to tackle issues in food security, including:

- Improved livestock production (through feed conservation and management)
- Dietary diversification to tackle malnutrition (introduction of mung bean)
- Positive Youth Development (a strategy to build the agriculture community and ensure ongoing support and engagement of youth)

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