Grand Plans for Grand Challenges

Grand Challenges Development & Implementation Report • February 2014

College of Agriculture & Life Sciences, Texas A&M University

AGRICULTURE & LIFE SCIENCES
TEXAS A&M UNIVERSITY

Chapter 1. Executive Summary of Process and Outcome

2012 was the 150th anniversary of the Morrill Land-Grant Act, which led to the establishment of Texas A&M University. The College of Agriculture and Life Sciences wanted to be sure to stay true to its land-grant mission while working to address future societal problems. In a recommitment effort to our land-grant mission, the College embarked on an exciting interdisciplinary, faculty-driven initiative during the 2012/2013 academic year to chart our priorities for the future. The process began by answering a series of questions: What are the issues? What areas of expertise or strength do we have? How do our strengths guide us? What problems might we encounter? What resources are needed? What are the steps to move forward? At the end, the answers to these questions helped define and develop the College's five Grand Challenges: **Feeding our World, Protecting our Environment, Improving our Health, Enriching our Youth,** and **Growing our Economy**. These Grand Challenges represent large and complex problems that our society will face in the coming decades which can be addressed through research, teaching, and service in academic fields found in the College.

Beyond answering these stimulating questions, the process for developing and refining these Grand Challenges involved the selection of speakers for the Blue Bell Lecture Series, the 2013 Texas A&M AgriLife Conference, faculty-led white paper development, the Grand Challenges Town Hall, and the 2013 Agrilife Administrative Retreat. Through a generous endowment from Blue Bell Creameries, the Blue Bell Lecture Series gave the College external perspective from global leaders on how it can uniquely approach the Grand Challenges. At the 2013 Texas A&M AgriLife Conference, more than 100 attendees split into small groups for each Grand Challenge topic to define the issues and brainstorm areas of strength and opportunity, as well as any potential problems. This step led to the formation of facilitated faculty groups who developed white papers plans on each Grand Challenge topic. The discussion from the 2013 Texas A&M AgriLife Conference session served as the starting point for the white papers, which were then refined by the smaller group. The white paper plans were presented back to the larger faculty at the Grand Challenges Town Hall. Once the white papers were presented, the Town Hall attendees participated in break-out groups to further discuss each topic and items highlighted in each white paper. The final step of the Grand Challenge development process was the 2013 AgriLife Administrative Retreat. During this retreat, administrators addressed the Grand Challenges and their impact on the College, Texas A&M AgriLife Extension, and Texas A&M AgriLife Research.

Through this process, it became evident that, while each Grand Challenge has a different focus, a number of cross-cutting themes emerged: health, human capacity, food, water and ecosystems. To refine these themes, as well as to bring together the five Grand Challenges, a unification committee was formed from representatives of each of the five faculty-facilitated faculty groups. Their result was a vision that the cross-cutting themes can be thought of to build across the Grand Challenges so as to increase human empowerment and capacity (Fig. 1). These unifying, cross-cutting themes will be the framework around which the implementation is accomplished with oversight council

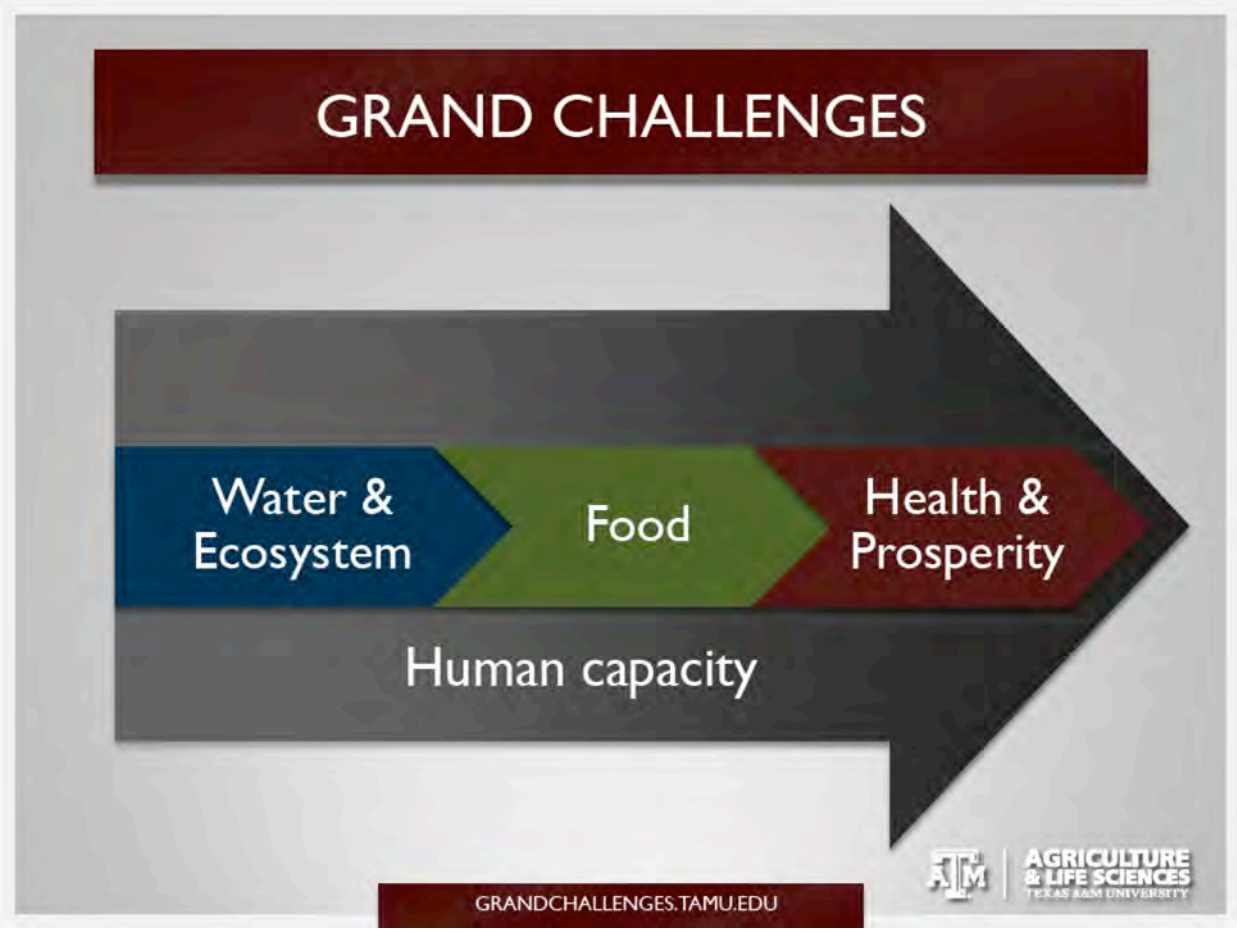

Figure 1

comprised of department heads and faculty leaders. Water and ecosystems are the basis for food production which is essential for health and prosperity. Furthermore, the Grand Challenges were not seen as a change in the course or a new set of research foci for our disciplines, but, rather, a recognition that there is incredible potential at the interface of these disciplines to solve the Grand Challenges and we need strong disciplines to also have strong interdisciplinary efforts. From a strong base of funding and infrastructure comes a variety of disciplinary and interdisciplinary research that create/contribute to major initiatives to address the Grand Challenges (Fig. 2).

In addition to cross-cutting themes, common needs emerged out of the white papers as well. The major shared needs were more effective faculty networking and teambuilding, more facilitation of major proposals/initiatives, better shared/core facilities, and a better system for fostering and supporting interdisciplinary efforts. Moving forward, exploring the commonalities in these themes, needs, and priorities with those of the Texas A&M AgriLife agencies, Texas A&M University and other Texas A&M University colleges will be imperative. It will also be essential to explore opportunities and synergies with other universities in the Texas A&M University System. Engaging development efforts to generate new sources and larger amounts of funding for the Grand Challenge efforts will also be critical. Finally, continuing to have these Grand Challenges be faculty-driven and faculty-led will be necessary for their success.

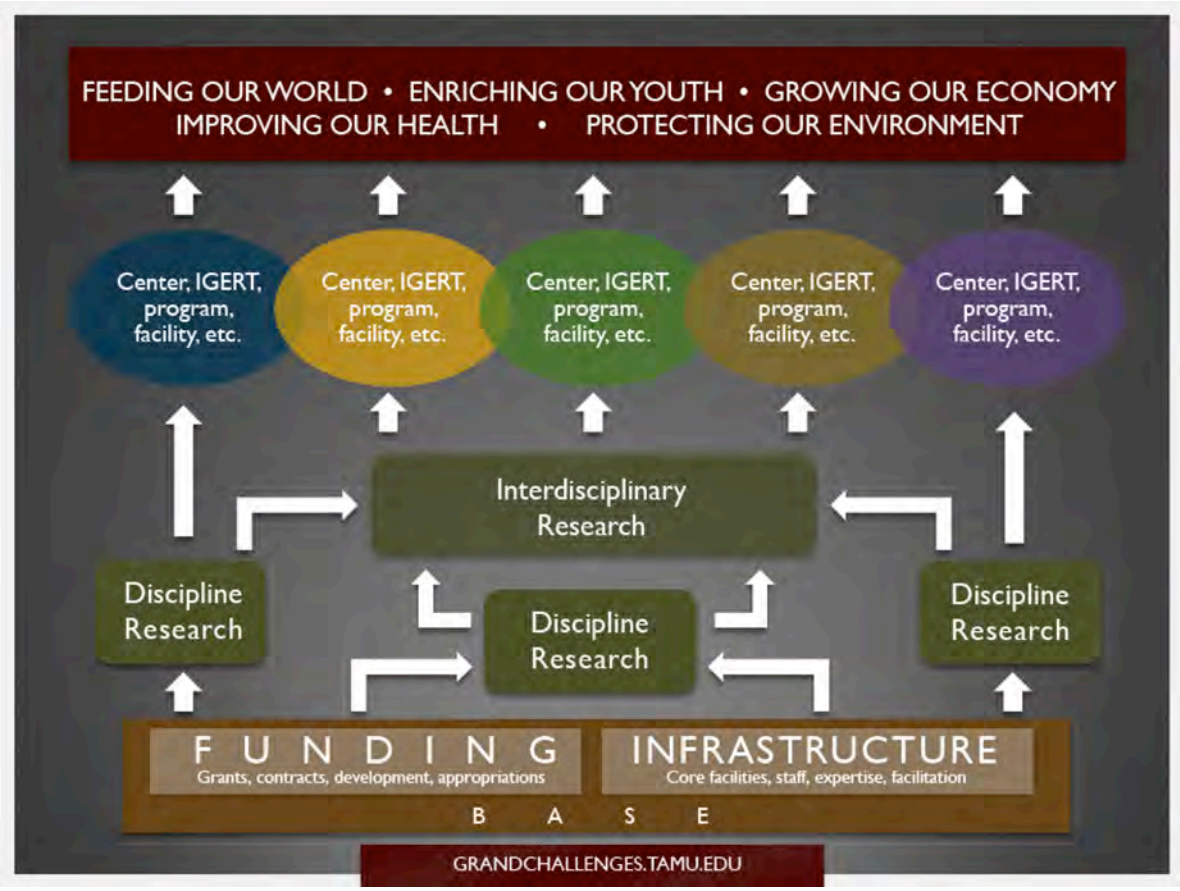

Figure 2

The Texas A&M University College of Agriculture and Life Sciences will continue to focus on its land-grant mission by developing new, innovative, and interdisciplinary ideas. By concentrating on developing solutions for its five Grand Challenge areas, the faculty and administration in the College will actively create opportunities today that will improve future generations.

The College of Agriculture and Life Sciences at Texas A&M University is one of the largest colleges of agriculture and life sciences in the country with over 400 world-class faculty, 7000 students, and 100 programs in 14 departments, the College is widely recognized as a leader in dozens of disciplines. Texas A&M University is the designated land-grant institution in Texas and the College of Agriculture and Life Sciences believes that the research and contributions it creates today build tomorrow's leaders and directly benefits the public in Texas, the nation, and the world. Teaching, research, and service are of equal importance in the generation of these contributions, which assist many, from individuals to the international community.

Chapter 2. Subcommittee Report on Grand Challenge: Enriching our Youth

Subcommittee Members: Gary Briers, Kevin Heinz, Toby Lepley, Corliss Outley, Shawn Ramsey, Lisa Whittlesey; **Facilitator:** Danielle Harris

Background Information

Providing the supports, opportunities, programs and services to assist Texas youth to grow to be fully productive citizens presents significant challenges to families, our education system (from pre-school to higher education), youth serving organization and a variety of government organizations at every level. Besides the normal tasks of growing up, youth face an increasingly complex world. To aid in a critical discussion around solutions, the committee has provided the context of changing culture, demographic diversity, and a clarification of the term "youth." A further reflection of rapid changes in technology; increasingly diverse demographics and culture; expanded, yet not always fully accessible, educational opportunities; a growing obesity rate, and challenging economic issues will be addressed as focus areas.

The Changing Culture and Diversity of Texas

The demographics and cultural diversity of Texas is changing rapidly. As of 2010, Texas had the second largest population in the United States, exceeding 25 million people, with 28% of the population less than 18 years of age. As the population continues to grow, so does the cultural, racial and ethnic diversity of the state. Approximately nine million (38%) Texans are of Hispanic descent, 2.8 million (12%) are African Americans, and 1 million (4%) are other non-Anglo, mainly of Asian descent. By the 2020, it is expected that Texas will have more persons of Hispanic descent than any other racial or ethnic group.

In addition, Texas continues to be one of the desired places in the United States to live and work. Net immigration to Texas accounts for almost half of the population growth in recent years. More than 171,900 college graduates moved to Texas each year between 2006 and 2008, a record exceed by only one other state. Texas is the second largest in the country in terms of square miles (268,601), with 83% of the population living in urban area, three of the top ten largest cities in the Nation, and many cities being among the most rapidly growing in the country.

Texas continues to be a family oriented, working state. With one of the lowest unemployment rates in the country and an expanding economy, people see Texas as a great place to reside. According to the 2010 U.S. Census, Texas gained more population than any other state in the last ten years by adding 4.2 million people.

Changing Educational Opportunities

With an increased population in Texas there is increased demand on all levels of the education system. From expectations of standardized testing in secondary schools, to the maintaining an affordable cost and reasonable access for higher education institutions, educational providers and government agencies are challenged to provide the economic support, reasonable access, and appropriate content to prepare students for the workforce and their roles as educated citizens.

The cost of higher education has been steadily increasing. Between 2000–01 and 2010–11, prices for undergraduate tuition, room, and board at public institutions rose 42 percent, and prices at private not-for-profit institutions rose 31 percent, after adjustment for inflation. The inflation-adjusted price for undergraduate tuition, room, and board at private for-profit institutions was 5 percent higher in 2010–11 than in 2000–01. For the 2010–11 academic year, the US Department of Education National Center for Education Statics reported that in annual current dollar prices tuition, room, and board for undergraduate education were estimated to be $13,600 at public institutions, $36,300 at private not-for-profit institutions, and $23,500 at private for-profit institutions.

In addition to the rising cost of education across the United States and Texas, many more students are entering higher education institutions with college credits completed in order to minimize college costs and to position themselves for better acceptance into a particular college/university. Research indicates that students participating in credit-based transition programs have a higher completion rate of a college degree, especially for those in underserved areas (Struhl & Vargas, 2012). According to Struhl and Vargas, in 2010 more than 90,364 high school students in Texas were enrolled in dual credit courses. With this increased number of youth entering college with advanced hours, teaching styles may need to be adjusted. Due to age and/or maturity level of student and their previous exposure to formal higher education classroom settings, it will be necessary to look at how these individuals are taught in the future.

The Changing of Youth – understanding who we work with

The United Nations define "youth" as any person between the ages of 15 to 24 years. Individuals under the age of thirteen are defined as "children." To appropriately address the needs of youth in Texas, we augment this definition of youth to include those age 13 to 24 years old. Regardless of the terminology and the age distinctions used to define youth, enabling young people to successfully transition to adulthood is the priority. Communities across the United States and Texas are searching for the best ways to facilitate positive pathways for youth to follow on their journey to adulthood. Agencies and organizations working with youth have created services and programs to decrease negative behaviors such as drug use, engagement of unprotected or early sexual activity, involvement in in gangs, and low school performance or dropping out of school. At the same time, agencies and organizations have sought to help youth develop the positive attitudes, skills, and behaviors that will enable them to successfully transition to adulthood.

Recent research shows that American youth have made tremendous progress in overcoming some of the behaviors that decrease life chances. For example, there has been a decrease in rates of teen births following a period of increases; decreases in the number of youth who are heavy drinkers or smokers; and increases in the number of students completing high school. However, data also indicates that there has been a steady increase since 1998 in the number of youth living in poverty; an increase in children and youth experiencing food insecurity; and the number of parents that have employment security is at its lowest rate since 1996.

Research also shows that American youth spend 42% of their time in leisure related activities. These activities include activities such as playing sports, attending church, being involved in hobbies,

watching television, as well as the use of social media. Constructive use of out-of-school time has been show to increase positive social behaviors, prevent risk behaviors and provide settings for social support from peers, parents and other caring adults. In addition, quality out-of-school time activities enable youth to achieve higher academic levels, demonstrate greater optimism about their future and become active productive citizens. Organizations that provide positive activities through intentional activities continue to need support in program design, program management, fundraising strategies, staff training, and program evaluation, Facilitating organizational capacity for quality youth development opportunities that will increase the probability that youth will make a successful transition to adulthood (i.e. being economically self- sufficient, form meaningful relationships with others, and being good citizens). Despite changing demographics, many youth of color have been underserved or inappropriately served by both government funded social service systems and private and non-profit sector organizations. Additionally, providers of youth programs and services too often have inadequately addressed culturally-based perceptions and behaviors, such as value orientation, ethnic identity, social capital supports (e.g., caring adult role models), language and acculturation, religious beliefs and practices, and family structure. Therefore, it is important to understand cultural context, the recruitment and retention of youth in select programs and services, and how it influences the overall development of youth as they transition to adulthood.

Focus Areas

The Engaging Youth subcommittee identified four priority areas regarding youth in Texas. The areas were decided upon based on current and future issues affecting youth and their transition to becoming productive adult community members. Those identified areas include:

1. *Promote Health and Wellness of Youth.* The health and wellness of our youth is a serious issue for our state, country, and world. Our youth are growing up with challenges not faced by previous generations. During this time period youth establish patterns of behavior and make lifestyle choices that affect their current and future health status and general well-being. With significant increases in obesity, diabetes, violence, growing dependence on technology, and other juvenile health issues, a focus on health and wellness is a priority. In addition, many youth continue to struggle with adopting positive behaviors that could decrease health risks, including healthy eating habits, engaging in adequate levels of physical activity, and avoiding drug, tobacco and alcohol use. Furthermore, research has found environmental factors such as family, peer group membership, and school and community characteristics may also contribute to overall youth health and risk behaviors. A focused community approach is needed to emphasize the engagement and partnering of multiple sectors needed to improve overall well-being. These health issues must be addressed aggressively with youth and their families through the combination of education and youth programs utilizing best practices. Finally, the college alongside the AgriLife agencies needs to provide information that will help guide the discussion at the local, state and national levels to improve community, state and national efforts for monitoring and decision- making about these issues.

2. *Facilitate Academic Achievement, College Readiness and Career Development.* Preparing youth for the college experience is beginning at a younger age. As a result, the stress of academic achievement presents challenges for many young people. Many young people need help to create aspirations to attend college earlier in in their school careers, elevate their expectations and dreams. Helping young people develop an

educational plan is necessary in order to enhance the thought processes about the value and need for higher education. Additionally, the academic culture in higher education needs to enhance the advising and guidance processes as youth they enter college, including assistance with career exploration to aligning classes to support career goals. Students, whether they are college bound or not, also need to be prepared for a job market that is increasingly specific in the skills required to be successful. Youth can be become overwhelmed without the skills necessary to navigate the sea of information about jobs and needed skills. Some universities and colleges have moved away from allowing entering students to be undecided with regard to their major, but at the same time forcing them to choose a major with limited information. School districts are not providing sufficient focus on career guidance to enable students to make informed choices about their future, whether to pursue college or industry related positions. Career guidance needs to be enhanced to enable students to make more informed educational decisions. This process includes the promotion of positive attitudes, skills, and behaviors around occupational and career choices and decisions. Thus, their need to be enhanced processes to promote work-readiness skills, career interest assessments, increased leadership opportunities, connection to communities through service, civic engagement, and involvement in work that provides advancement, satisfaction and self-sufficiency.

3. *Build and Sustain Collaborative Partnerships among Governmental, Educational and Non-Profit Agencies to Support Youth Development*. As a land-grant university, the mission of Texas A&M is to disseminate education to the citizens of Texas. This practice includes engaging faculty members in the community through the translation of research into practice through the utilization of all areas of the AgriLife program, including the college and the agencies. Collaboration with government, industry, foundations, and other funding sources for research and outreach involving youth and youth issues is also vital. In order to the success of youth in identifying pathways to adulthood, government agencies, community organizations, schools, and community members need to work together in a more comprehensive approach. As such, joint efforts can help promote a more comprehensive approach that views each youth from a holistic perspective, recognizing the unique role that each sector play in ensuring the development of youth into healthy productive members of society.

4. *Training for Staff.* In today's higher education setting, it is imperative that faculty and staff are offered adequate training opportunity to be cutting edge faculty members. Training is critical in five areas: technology, risk management, exposure to issue affecting youth, mentoring, and professionalism. It is imperative that the latest technology is used to deliver educational materials to our students, including understanding new technology, having access to it, and creating expectations to use it. Risk management is becoming a larger issue for all who work with youth – from how to work with them, properly involving them in programs, and the impact of risk management factors on quality programs. Knowledge of youth issues is also critical. To be an effective educator, one needs to be knowledgeable of youth issues such as violence, bullying, obesity, sexuality, and how youth learn and are engaged in the learning process. In addition, training faculty and staff to be positive adult mentors is becoming more and more important for working and engaging youth. As more young people have less positive influences in their daily lives, adults have the obligation to serve as mentors for young people in order to prepare them for their education and/or career experiences.

Capacity Building

The subcommittee examined multiple areas within the college to identify programmatic strengths. It is believed these areas would be places to build capacity to make significant contributions regarding the priority areas. Examples of research, programs or events have been provided to illustrate efforts in this area. While not an exhaustive list, these efforts demonstrate leadership that can be maximized.

1. *Health and Wellness of Youth (i.e.: childhood obesity, identity issues, etc.)*
    - Research throughout the college:
        - Research briefs through Sequor Youth Development Initiative (YDI) including emerging topics and literature reviews
        - Texas Grow Eat Go program evaluating the impact of intervention programs to improve physical activity and eating behaviors of children at selected elementary schools
        - Institute for Obesity Research and Program evaluation has worked with the Texas Department of State Health Services to assess the WIC program new food packages and evaluate the impact of two national policy implementations in Texas
        - Role of Social Sciences in feeding the world in Agricultural, Leadership, Education & Communications with teachers in high schools
    - Research & extension programs across the state
        - Hippotherapy certification program with Extension provides theory and practice for individuals working in equine assisted therapies
        - Junior Master Gardner
    - Engagement of youth:
        - 4-H MASH camp
        - District 4-H Leadership Labs
        - Texas 4-H Conference Center leadership camps
        - Junior Master Gardner workshops
2. *Academic Achievement and College Readiness*
    - Research throughout the college
        - Toyota grant with Agricultural Leadership, Education, & Communication
        - CYFAR Life Skills program
        - Success characteristics of targeted student populations in Science, Technology, Engineering, & Mathematics (STEM) disciplines
        - Use of experiential learning in agricultural education classrooms
        - Mentoring models with underrepresented youth
        - Recruitment and retention of underrepresented youth in agriculture and life sciences

- Training & trainers on variety of topics:
    - High Impact Program funded advisors to experience programs in departments in order to stimulate student interest
    - Webinars on critical issues in advising students (i.e.: counseling undecided students, understanding returning veteran issues, etc.) for academic advisors
    - University Advising Council (UAC) provides professional development for campus based academic advisors
    - Agricultural Science Teacher certification program grooms potential teachers
    - Sequor YDI annual conference
- Promotion of higher education:
    - Outreach programming & AVID presentations with schools
    - College recruiters
    - Articulation agreements with community colleges,
    - Rural Talent Search
    - Greater Texas Foundation through Texas A&M to reach target populations in Texas
- Engagement of youth:
    - Initiatives in multiple departments (including Biochemistry, Entomology and Animal Science) in the college allow undergraduates to engage in the funded scholarly research alongside faculty mentors
    - Myriad of contests and clinics to develop skills in animal science, horticulture, public speaking, robotics, and food safety
    - ExxonMobile Bernard Harris Zombie camp exposes middle school students to STEM disciplines in order to stimulate their interests
    - Learning communities (L3C & CLUES) to build support systems for undergraduate scholars

3. *Career Development*

- Research throughout the college
    - Student interest in agriculture & life science in Agricultural Leadership, Education, & Communication
    - Leadership development in volunteer groups (4-H, FFA, MANRRS, etc.)
    - Career awareness of students enrolled in agricultural and/or life science programs at colleges and universities
    - Success characteristics of targeted student populations in Science, Technology, Engineering, & Mathematics (STEM) disciplines
    - Effective instructional methods with agricultural teachers
    - Coping and support services for youth in out-of-school programs
    - Cultural competency and youth development
- Extension personnel across the state provide workshops to students and the community at large about a variety of subjects related to agriculture and life sciences. Internships for both high school and college age students are provided at some Extension Centers.

- Promotion of higher education:
    - Ag in the City affords the San Antonio community an opportunity to experience agriculture
    - Agriculture & Life Science College recruiters provide workshops on affording higher education and ways to attain college degrees to communities around Texas
    - Partnerships with community colleges to matriculate students into degree programs within the college at Texas A&M
    - Ag Day @ Blinn and Lonestar community colleges provides exposure to opportunities within agriculture and life sciences at Texas A&M to community college students and counselors
    - Partnership with the College of Veterinary Medicine to support youth camps encouraging youth to select veterinary medicine as a career
- Engagement of youth:
    - Summer Training in Agriculture and Related Sciences (STARS) gives students a glimpse of opportunities available to them in agriculture and life sciences
    - Kids2College affords middle school students an opportunity to see the benefits of a college education
    - World Food Prize Youth Institute exposes students to interdisciplinary solutions needed globally to resolve issues of food insecurity, poverty and hunger
    - AG4U at HLSR provides participating Houston area schools an opportunity to gain better understand about the intersection of agriculture and living in an urban environment

4. *Collaborations and Partnerships*

- Build capacity of youth service providers through technical support
- Provide training & facilitators on variety of topics
    - Sequor YDI partners with local youth agencies to provide various training on emergent youth development issues
    - Academic departments within the college provide professionals in residence to industry representatives
- Formal agreements:
    - Prairie View A&M University partnership with Agricultural Leadership, Education, &Communication to teach multiple courses
    - System Admission Agreements through Admissions assists the college and the university in providing college admission opportunities to youth in Texas
    - Hispanic Leadership in Agriculture and the Environment is a partnership with the college, USDA, and the US Forest Service focused on developing leaders researching issues in agriculture or the environment that affect Hispanic communities
    - Houston Livestock Show & Rodeo(HLSR) and San Antonio Livestock Exposition (SALE) – providing internships, scholarships, and agriculturally based programming to youth

- Engagement of youth:
  - Agriculture and Natural Resource Policy Internship provides internship experience for those students interested in public policy
  - Study Abroad programs are housed in several academic departments for undergraduates and graduate students to participate in.

5. *Training for Staff*
   - Research throughout the college:
     - Sequor YDI briefs and parent information sheets
     - Sequor YDI Evaluations: Camp Counselor study for ACA, CYFAR 4-H program, UPBEAT Final Reports and Toolkits
     - Extension Volunteer trainings: JMG & 4-H
   - Training & trainers on variety of topics
     - Trainers available through affiliated list of faculty in Sequor YDI
     - Fostering collaborations & partnership development
   - Research & extension centers across the state:
     - Lab safety training
     - Volunteer Training through 4-H
   - Promotion of higher education:
     - Cross Training for college recruiters jointly facilitated with Admissions and Financial Aid to discuss updates in policies and programs affecting incoming students
     - Undergraduate emphasis area and certificate in Youth Development in Recreation, Parks and Tourism Sciences
     - Graduate degrees in Youth Development in Recreation, Parks and Tourism Sciences
     - Joint Doc@Distance program with Texas Tech University for students in Agricultural Leadership

Goals, Needs, Outcomes and Strategies

Promote Health and Wellness of Youth

- Goal: improving quality of life & health for youth in Texas by addressing state priority issues:
  - Childhood Obesity,
  - Bullying and Violence,
  - Healthy Identity Development, and
  - Develop habits of health-promoting behaviors (e.g. exercise, conflict resolution, stress management, & coping skills)
- Needs:
  - Coordinated interdisciplinary research teams to discover and disseminate knowledge regarding programmatic innovations addressing priority issues for youth

- Increase available supply of translational research regarding youth for practitioners
- Promote positive interpersonal/social development of youth through research, education and outreach

- Strategies:
  - Organize and distribute collaborative interdisciplinary research and demonstration programs to service providers in high-need areas
  - Collaborate with community partners to implement demonstration programs on priority areas
  - Create direct service demonstration programs (after school, camps, playground programs) intentionally addressing priority issues

Facilitate Academic Achievement, College Readiness and Career Development

- Goal: preparing youth for successful living and meeting tomorrow's challenges
- Needs:
  - Directed support strategies for students not attending college
  - Intentional efforts toward developing needed skills in youth:
    - Daily living skills
    - Job skills (including customer service/guest experience)
    - Perspective taking skills
    - Strong understanding of self
- Strategies:
  - Create a Career Development Center providing resources/materials to aid youth practitioners, counselors, and teachers in guiding youth (middle and high school level) in connecting their talent/academic potential with market offerings
  - Combine and redefine "success" metrics across units to increase collaboration and reduce silos
  - Create and maintain a central web database of trainers and topics related to academic preparation of youth for college
  - Sponsor camps and enrichment programs facilitating awareness and importance of higher education (associates, bachelors, and graduate degrees) as well as agriculture and life science disciplines
  - Facilitate better linkages with community colleges, teachers, educational service centers, and school districts as partners for high need areas (eg: STEM)

Build and Sustain Collaborative Partnerships among Governmental, Educational and Non-Profit Agencies to Support Youth Development

- Goal: optimize the efficacy of organizations in the Texas youth-serving industry

- Needs:
  - Formalized unified partnership(s) between the college, Sequor YDI and AgriLife agencies to support youth initiatives
  - University level support and buy-in with Youth Development Initiative to guide risk management protocols addressing youth on campus
- Strategies:
  - Establish connections with foundations and community groups to sustain an urban focus within Texas
  - Create greater flexibility in shared infrastructure (i.e.: accounting, communication, marketing, web support, etc.)
  - Identify and overcome impediments to increase collaboration between units across the college and affiliated agencies
  - Increase capacity of Sequor YDI to facilitate centralized and online training programs for youth practitioners

Training for Staff

- Goal: improve delivery of quality programming, research,
- Needs:
  - Strengthen web presence at the college level to warehouse: central databases of trainers/topics, camps and/or enrichment programs
  - Training facility to host staff trainings for college, agencies as well as youth state youth practitioners
  - Increase the visibility and function of Youth Development Initiative to facilitate centralized & mobile training for youth practitioners
- Strategies:
  - Design mobilized trainings offered to staff (agency and college) on youth issues, technology, and professionalism
  - Develop trainings to address linkages with community colleges, teachers, and counselors working with youth
  - Provide better recognition or credit in the promotion tenure process for participating faculty
  - Create volunteer training to address former students and retired professionals as resources for mentoring and advocates for youth

External Supports and Resources

- Foundations and out-of-school time program providers
- Workforce Development funders
- Endowed funds and increased fundraising from the AGLS Development Office
- Department of Education grant funds

Chapter 3. Subcommittee Report on Grand Challenge: Feeding Our World

Subcommittee Members: Clinton Allred, David Caldwell, Rhonda Miller, Elsa Murano, Elena Castell-Perez, Wayne Smith; **Facilitator:** Chris Skaggs

Introduction

Feeding our World is a grand challenge encompassing multiple facets of the College of Agriculture and Life Sciences at Texas A&M University. The challenge involves feeding nine billion people by the year 2050. The challenge to increase food production will rely on advances in technology. Funding for agricultural research is flat or trending downward in comparison to other industries and especially other countries such as Brazil and China. Research is critical to address the challenge and will require integration of soil, plants, poultry, fish, and animals. Challenges also exist in distribution channels, resulting in unnecessary excesses and deficiencies of agricultural products. Policy restrictions as well as transportation, storage and distribution issues currently exist. Post-harvest losses must be minimized as well. Food security will also be paramount to the initiative. While advancements in technology are adopted in the United States, barriers exist in other parts of the world. According to Dr. Robert Thompson in his Blue Bell lecture, the challenge to increase production by 2050 coincides with limited increases worldwide in productive land, reduction in land availability and a concomitant reduction in water usage. Water availability and quality will be of significant importance as well as climate change.

Texas is a geographically diverse state with Texas A&M AgriLife Research and Extension Centers and activities strategically located to focus research efforts to address diverse climatic, edaphic, geographic, and cultural conditions. Extension programming exists in 252 of our 254 counties providing an excellent infrastructure for technology transfer. Challenges include populations that are metropolitan, urban, and rural with different needs that can be addressed by Texas A&M AgriLife. International outreach occurs through the College of Agriculture and Life Sciences educational programs and the Borlaug Institute.

Focus Areas

The subcommittee identified five areas of emphasis for the Feeding Our World grand challenge of the college including: (1) Breeding/Genetics of Plants and Animals, (2) Technology/Food Safety, (3) Resource Management-Water/Land, (4) Development of Nutritious Foods/Feeds and Education, and (5) International Development.

Breeding/Genetics of Plants/Animals

Genetic advancements in plant and food animal production have made significant contributions historically to the food and fiber supply chain through increased productivity. Enhanced disease

resistance and environmental tolerance have boosted productivity and the need exists to continue development of plants and animals adaptable to environmental change. Adaptability to climatic change is paramount to provide adequate food for societies to thrive. Research initiatives will include development of plants adaptable to biotic and abiotic stressors. Enhancing the innate immunity of plants to respond rapidly to exotic pathogens is important. Likewise, factors impacting animal health will need to be continually addressed. The increasing global population and demand for food have intensified genomic research efforts to identify further improvements in productivity/yield, quality and efficiency while minimizing environmental impact. Phenomics and metagenomics research take advantage of the tremendous advances in genomics of the past decade within the multiple disciplines, both plant and animal, of the college. Educational efforts to enhance transparency from production to consumer and demystify genetically modified organisms to consumers will need to be addressed.

Technology/Food Safety

Improvements in technology have resulted in increased food production to meet global demand. Post-harvest machinery and production techniques have evolved to address food safety concerns yet one third of food loss today occurs post-harvest. Efforts have been made to produce more and more product, yet losses exist through complications post-harvest. Research and development of preventative and diagnostic tools for early detection, monitoring and trace back of contaminants to improve food safety will be critical. Pre-harvest animal protocol greatly impacts post-harvest problems. Infrastructure is needed to deal with food waste. Extension programming provides training for producers and processors and educates consumers. Agricultural advancements in post-harvest technology are sometimes met with apprehension by consumers resulting in need for educational programs to address such concerns. Consequently, the role of extension is significant for consumer acceptance.

Resource Management and Conservation – Water/Land

Water availability and drought dominate rural and urban concerns in Texas. The College of Agriculture and Life Sciences must provide the educational, scientific and scholarly framework for the understanding, development, management and use of natural resources to benefit human and natural societies. Sustainable intensification is the objective to maximize the use of limited resources through precise methods in a manner that is considered sustainable. Drought impacts crop production which ultimately impacts the value of feed necessary for livestock enterprises. The recognition and importance of biofuels to decarbonize the energy sector through minimizing carbon dioxide emissions and ultimately reduce carbon footprint by mitigating climate change is one of college's research strengths. The college will concentrate on a systems approach to address water/land issues. Research initiatives address the framework for sustainable land production with reduced water, energy and fertilizer inputs. Several departments will provide expertise on water quality systems and training. Water is an expensive commodity with competition between urban and rural interests. Reclamation efforts to remove pathogens from water for reuse will need to be

addressed. Multidisciplinary or systems thinking will be required to address the complexities and intricacies of resource management.

Education and Development of Nutritious Foods and Feeds

The college will serve a leadership role in discovery and dissemination of new knowledge in nutrition and food science to promote public health and well-being. Educational outreach to nutritionally at risk populations in Texas and beyond is necessary to promote healthy lifestyles and prevention of diet-related diseases. Communication is critical to prevent misinformation concerning nutrition. Development of new foods or food products or new varieties of existing crops to provide nutritional, high quality foods will continue to be prioritized. Discovery of dietary mechanisms and factors impacting obesity, cardiovascular disease, carcinogenesis, diabetes, and other chronic diseases will be addressed. The need to educate physicians on diet and nutrition issues is critical. Population-specific research is also needed in nutrition. The college will continue involvement in policy development as related to agricultural production, imports and exports, with goal of enhancing competitiveness of Texas and U.S. Agriculture.

International Development

The College of Agriculture and Life Sciences has a strong presence around the world impacting global food production. The Borlaug Institute serves as a hub for international activities. The institute helps small-scale farmers around the globe to prosper through improved crop varieties, animal genetics, product handling, transport, food safety, nutrition and food policy marketing. The mission revolves around helping countries to produce their own food in a sustainable manner to decrease dependence on imports. The Borlaug Institute focuses on providing modern technology to help farmers efficiently produce crops and livestock for a profit. The Borlaug Institute also works to enhance education in colleges of agriculture in foreign countries. Recommendations are made from planting to harvest to enhance production efficiency. International outreach and consulting opportunities exist for faculty involvement. Longer sabbaticals of up to 6 months may provide a crucial time threshold to accomplish progress. Short courses of 1 to 2 week duration may also play a role in reaching the continuum from production to consumption. Training and educational programs will help address gender equity in the global farming enterprise. The approach of hosting veterinarians, faculty and graduate students from other countries and place them in laboratories of faculty at TAMU expands international collaborative and research impact. Distance and continuing education programs in plant and animal breeding and genetics will provide opportunities for Texas A&M and the College to impart knowledge and skill sets worldwide. Distance delivery of information in other disciplines will expand the sphere of influence and help alleviate hungry and poverty through transfer of information. Novel programs such as reciprocal exchange and sandwich programs to bring graduate students from foreign institutions to Texas A&M for 6 to 12 months and send U.S. students to foreign university or agricultural research organizations will expand the influence and exchange of knowledge of the college. Dedicated funding to establish these kinds of activities in developing nations could pay dividends in alleviating hunger and poverty.

Challenges

The technology and scientific discovery exist but a mechanism of dissemination may need refinement. The college does outstanding work but how do we go about sharing with world? Technical assistance may be required to assist with integration of efforts. Continual breakdown of barriers is essential to encourage collaborative approach. Connecting people by removing barriers can sometimes be achieved through centers or institutes, or through incentivizing faculty and unit heads to pursue collaboration. Increased incentives, increased services and a reduction in structural and procedural barriers will promote collaboration. Professional grant writers working on college level with familiarity of research agendas of AgriLife Research and the 14 departments might assist with leading some collaborative efforts. Encouragement of interdisciplinary, intra-departmental research/extension efforts is necessary. The college is highly leveraged with significant grant performance and industry ties which leads to less flexibility to move to current issues. The re-organization of Texas A&M AgriLife Research and Extension Centers into innovation laboratories may serve as model to better promote collaborative research. The change of focus from commodity-based to issues-based orientation at centers should foster integration of efforts. Funding for agricultural research will continue to be a challenge with current downward trend in support in the United States as compared to Brazil and China. The diversification of research portfolios to increase funding opportunities and competitiveness is a priority. Funding opportunities at the federal level beyond USDA and through private entities are essential. Increased urbanization and sprawl will impact land availability for agriculture and hasten exploration of novel concepts such as large hydroponics facilities to raise crops. Extension must continue outreach efforts to small-scale producers of plants (gardens) and animals (small acreage cattle operations).

Strategic needs

The grand challenges provide framework for future priorities of the College of Agriculture and Life Sciences. The land-grant mission of providing consistent flow of information to reach clientele in their homes could occur via satellite and Internet television programming. Strategic needs include continued emphasis on educational and extension programs both inside and outside of the United States, problem-based sabbaticals for faculty in international venues, sandwich/2x2/reciprocal exchange programs through agreements with international universities and distance education to reach the public. Positioning of the College of Agriculture and Life Sciences to anticipate research initiatives and future direction of granting entities will impact future research support. Enhanced communication between federal relations and development officers to find donors for research initiatives is essential. Technical assistance is a concern with need for more technicians to enhance discovery efforts. Graduate student support should be prioritized to attract the highest quality students. Support to maintain infrastructure or existing facilities is needed. First-class facilities are also essential to attract new faculty. Development of more endowed chair positions to elevate

notoriety of faculty and attract the highest quality faculty is significant. The development of college-professorships to recognize excellence similar to the model used for Distinguished Professors at the university-level is one possibility. Feeding the world is a grand challenge with global implications and achievable through scientific and technological innovations, information transfer and political awareness of need for sustainability.

Chapter 4. Subcommittee Report on Grand Challenge: Growing Our Economy

Subcommittee Members: Christine Alvarado, Ron Lacey, David Mattarita, Ed Rister, Gary Williams, Jennifer Williams; **Facilitator:** Alan Sams

Introduction

The earth's population is expected to grow by 28 percent from 7 to 9 billion people by 2050. This population growth is further expected to be accompanied by a rising level of purchasing power and standard of living for many of the developing nations' populations. This suggests that there will be substantial growth in per capita demand for existing products but also the creation and evolution of new markets for products and services. It is therefore projected that the 9 billion people will consume at the present day rate of 12 billion people, a 70% increase over today's needs.

However, this population growth and market expansion will occur against a backdrop of an ever–increasing, interconnected global dynamic. Economies shift with the speed-of-light electronic communication. The political and cultural winds of emerging and unstable nations create additional limitations and constraints, sometimes at odds with those of more affluent and powerful countries. The expanding populations and increasing rates of consumption will place even greater demands on the natural resources of land and water needed to supply the market and economic expansion. The workforce needed for this expanded production and consumption marketplace will require new developments in education, healthcare, public services, and civil infrastructure. Rural development and sustainability are already a focus of concern, but will face more pressure and may even also experience new opportunities in foreign, developing countries as rural enterprises evolve there.

Among the myriad of products and services and manufacturing systems, our College is uniquely positioned to lead in the innovation and implementation for food-, energy-, and health-related industries. While we are not producers of products or services, we can provide leadership to grow our economy through the innovation we create and the education we provide to students and our stakeholders throughout their lives. Our agricultural breadth and depth of expertise and facilities make us world leaders in many commodities and intellectual innovators in adapting to new challenges and needs. This intellectual capacity has allowed us to branch out in novel applications of our agricultural roots. Biofuels and renewable energy have been a natural application of our plant and biotechnological science and engineering expertise. Likewise, our molecular knowledge and biological focus position us as leaders in disease prevention, detection, and treatment as well as in regards to the impacts of disease on commerce and communities.

The Economic Landscape

Global Dynamics Impact Agricultural and Food Industry

Globalization, the growing openness and integration of world economies over the last 10-15 years, is forcing shifts in the allocation of world resources and in the pattern of world production and trade and creating new ways of doing business, new opportunities for growth, new problems to be resolved, and new issues and concerns for producers, processors, wholesalers, retailers, importers, exporters, government policy makers and all associated private and public sector groups. Finance, tax and investment policies in Texas, USA and elsewhere create a business environment that can foster or stagnate economic growth. In world commodity markets, the trend toward interdependent globalization is forcing dramatic changes in how agricultural commodities get transformed and delivered to consumers. Communication as well as wide-ranging investment and trade climates can be both helpful and hindering to economic growth. Traditional U.S. commodity supply chains, faced with new and increasing global competition, have sought to remain competitive through reductions in costs and increases in productivity at all levels, creating greater interdependence between the various stages in the food chain and forming strategic alliances, networks, and other linkages to improve logistics, product flow, and information flow. Because not all commodity systems are globalizing at the same rate or in the same way, globalization is having a differential effect on markets for agricultural commodities, energy, and other natural resources, leading to additional uncertainty as producers and businesses struggle to adjust to the rapidly-changing global conditions and systems.

Sustainability

-Environmental

Meeting the resource needs of this growing world economy will place additional stresses on our global environment. The demand for energy, water, and land will all increase concurrently with possible changes in the amount of these resources that are available. Such phenomena suggest new production systems will be needed that are more efficient at producing outputs from inputs. These systems could include higher-yielding and drought-tolerant plants, new processing methodologies for food that allow it to last longer or be more nutritious or new sources of energy. The increases in production volume and/or efficiency will need to be done in such a way as to not increase needs of other resources and without producing adverse effects on the environment. Protecting the environment will maintain the natural spaces for recreation and the human as well as economic benefits it brings.

-Rural

In the process of growing our economy, special attention must be placed on rural areas which often contain the natural resources from which we obtain our food, water and energy while at the same time providing the space in which we recreate and dispose of our waste. Rural areas contain much of our cultural heritage which is important to our identity and our future. Rural areas also represent a substantial economic potential in terms of business to support varied enterprises and resident populations. A specific advantage of rural areas is that best practices frequently recommend that critical functions like food supply and other sensitive activities be done in geographically-dispersed

locations for purposes of decentralization and to assure some level of isolation security. The large spaces needed to meet our food and other needs will further assure that rural locations are part of our future; thus, these areas need to be protected and supported in their unique ways. While critical for the growth of our economy, rural areas often lack economic diversity and adequate civil infrastructure, rely on a limited number of industries, and contain a less-educated population than their urban counterparts. Often, these attributes result in higher levels of underemployment and unemployment. In addition, such areas present higher rates of poverty, and higher incidences of malnutrition, disability, and mental disorders. Each of these characteristics limits the ability of rural citizens to secure jobs and/or promote investments necessary to promote economic growth and good quality of life opportunities. Thus, the process of rural sustainability requires a careful balance of truly understanding the importance of these places for society in the light of the constant vulnerability they experience. Sustainable growth requires providing rural environments and people with the necessary infrastructure, technology, economic resources, information, and educational resources that can allow for a responsible and informed extraction and usage of the multiple resources they provide.

Human Capital

Economic growth can only be achieved through an educated, healthy, and engaged/responsible population. Whether this population is in the USA or in another country, the interconnected global marketplace demands we consider the needs of all people. A vigorous and prosperous population of customers is as important as one of workers and producers. Human potential cannot be reached in a hungry population. More people die in the world from hunger and malnutrition than from HIV, tuberculosis, and malaria combined. Furthermore, the vast majority of hunger in the world is caused by poverty, not politics or war. Thus, a growing economy can reduce poverty which reduces hunger and makes for a stronger economy. Our College is a global leader and provides the education needed for all aspects of this growth from the science and technological innovation, engineering design, health and well-being, trade and policy, economics and business, and training of future generations. Broad cross-discipline education is imperative to prepare future generations to assimilate new technologies and successfully integrate them into local, regional, national, and international economies. Learning is a constant and lifelong necessity in our rapidly changing world. The mobility of people and information creates special challenges for delivering this continual learning, but also opportunities for the College to be the provider of it. Leadership, innovation, and entrepreneurship permeate all of our educational programs. It is through this knowledge and these programs that we can stimulate, inform, and sustain a growing global and domestic economy.

Outputs

Food

Globalization has changed the way we identify opportunities to grow our economy. Due to the oncoming population growth, the concern for future decades is food security, a term used to describe being able to safely, adequately, sustainably, and economically feed the global population while ensuring that local needs are met. With this concern of food security and our own national

security is also an opportunity to explore markets, people, and business opportunities previously inaccessible or unknown. New innovations and varieties of foods as well as cultural, functional, and nutritional aspects of food will all become increasingly important and can add value to create additional economic growth. Research in product development of new foods for cultures across the globe as well as providing highly nutritious foods to countries in need will become a critical driver for economic development. Innovative technologies and infrastructure to enhance and protect the safety, shelf stability, transportation, and year-round global distribution of foods will create borderless opportunities for all and will propel the development of business and economic growth.

Resources

Issues related to resources and growth ultimately come down to the question of how does an economy sustain growth in light of finite resources. There is a range of scenarios from a coming doomsday when we reach peak oil, peak phosphorus, or some other limit that results in the demise of mankind on one end and status quo, change the assumptions, dispute the data, or minimize concerns on the other. The scientific reality is probably in between, is more complex, and suffers from limited data as well as huge interconnected systems, which we do not currently understand. Chaos theory attempts to capture the scope of the problem as do studies into dynamic systems and sustainability.

Much of our traditional thinking deals with resource issues and the question of "How do we do more with less?" Resources are the core issue of all other areas of focus: Food, Water, Health, Global Dynamics, Sustainability, and Human Capital. Food production is limited by land or water or nitrogen or phosphorus or some other resource. Water is both a resource input for production and a necessary requirement for human life. Health is constrained by limited potable water or mosquito netting or medicine or some other resource. Global dynamics deals with prevailing differences in economies' market power and the inequitable distribution of resources versus demand. Sustainability seeks to balance demand on resources with supply and human capital constrained by all of the above. The future also will need to consider the relatively poorly-understood interconnectedness of our global ecosystem as well as new, currently unknown resources and technologies that will change the current paradigm. We also should not consider resources as limited to what we currently have. Using synthetic biology to create new renewable energy forms or water alternatives are just two examples. Such game-changing opportunities will grow the economy by facilitating production and human well-being as well as by potentially creating new commodities and markets.

Health

Among the greatest growth potential and international need in the foreseeable future is the area of health. Whether it be in the areas of well-being and prevention or in diagnosis and treatment, our College is positioned to be a leader in research, teaching, and outreach. Included in this vision are humans, animals, and plants, and also the environment through the One Health Plus concept which interconnects these health systems. New knowledge, pharmaceuticals and treatments, vaccines, diagnostic tools, nutraceutical foods, lifestyle programs, and pest management are all areas in which

we are leaders with competitive advantage. These health technologies and programs, as well as the economics and policies guiding them, also play a major role in growing our economy through their critical role in international trade and travel. Preventing the spread of plant, animal, and human diseases are a key goal of many governmental and international policies. Our innovations as well as both educational and outreach programs are critical opportunities for us to stay compliant, inform decision makers on such policies, and keep our human, animal and plant populations healthy. A healthier population grows the economy through healthcare savings as well as productivity increases.

Experiences and Education

Not all outputs that contribute to economic growth are tangible. The pleasure and physical benefits one realizes from leisure activities and the personal or professional growth one obtains from learning are intangible gains for which people and society are willing to pay and support. Tourism is a multibillion dollar, world-wide industry focused on serving this need. Other, non-tourism leisure activities are quite varied, but are likewise important contributors to economic and human capital development and are often dependent on the environment. Education is a set of experiences, knowledge, and abilities that, in an intangible way, improve one's marketability, increase the productivity of their employer, or simply bring a sense of accomplishment. These products all grow the economy or at least improve human capital. In addition to the intangible nature of education as an output, the curriculum and materials that provide the learning are more tangible elements that can contribute to the economy.

Outcomes and Goals

1. Achieve a Title VI grant from the Department of Education (or similar, non-traditional grant) on growth of the economy through technological and human capital innovations in food/natural resource policy and trade.
2. Foster more public/private funding relationships. In particular, work with major foundations to obtain a major ($10-30M) grant to fund a/some program(s) that address large, complex problems of economic significance such as water, hunger, or international trade. This recognizes that our College's role in sustainable economic growth will depend on expanding (a) our funding base beyond federal grants, state appropriations, and industry contracts, and (b) our view of stakeholders beyond agriculture to include the many other industries and clientele we serve.

Strategic Needs to Accomplish Outcomes and Goals

1. Foster interdisciplinary networks and activities between faculty. Although such an integrated team approach is needed in many areas and many ways, one example is to create a program for "incubator sabbaticals" in which faculty from differing backgrounds are co-located for 9-12 months (on campus) to address a mutually interesting, but interdisciplinary issue/theme. Team seed grants to support collaboration and interdisciplinary initiatives would be another, similar approach.

2. Deeper faculty expertise and additional educational programs (courses) are needed in international trade and international development
3. Establish a focus on Latin America to better capitalize on our extreme competitive advantage there. These efforts could include many components such as faculty networking, funding for activities in teaching and research, as well as administrative facilitation.
4. Research facilitation in team assembly and facilitation as well as proposal development and management.
5. Develop better understanding among faculty and students regarding (a) the interrelatedness of value chains;(b) the business and economic aspects of technology development, adoption, and implementation; and (c) the legislative and other institutional attributes appropriate for enhancing the sustainable success of entrepreneurial ventures.
6. Establish a small business "incubator" or problem-solving consultancy mechanism that fosters creative and collaborative relationships between entrepreneurs and innovative faculty.
7. Optimize TAMUS policies and services regarding intellectual property to better foster innovation and external partnerships.
8. Capitalize on our brand strength and former student network in promoting our interdisciplinary problem-solving capacity/expertise through such venues as a website directory. A similar effort can promote our lifelong-learning opportunities (personal/professional continuing education).

Chapter 5. Subcommittee Report on Grand Challenge: Improving our Health

Subcommittee Members: Karen Beathard, Fuller Bazer, Elena Castell-Perez, Bhimanagouda Patil, David Scott, Rosemary Walzem; **Facilitator:** Kim Dooley

Introduction

From recreation and weight control to designing fruits, vegetables and animal products better able to prevent chronic diseases to improving human health and production efficiencies in livestock and using the latest advancements in biotechnology to search for new drugs, the College of Agriculture and Life Sciences at Texas A&M University is dedicated to improving health of humans, animals and plants. Our students in the life sciences will be among the leading research scientists and technicians, registered dietitians/nutritionists, physicians, pharmacists, and biotechnology engineers of the future. We believe in taking a leadership role in improving health by providing students and researchers with state-of-the-art equipment and facilities to investigate such areas as genomics and structure-based drug design combined with computer bioinformatics to find the molecular basis of disease and the right intervention to target a specific disease. Other research is aimed at finding nontoxic "smart drugs" that can be carried by nanoparticles directly to disease sites in the body. Programs aimed at nutrition and metabolism enable health outcome optimization through personalized assessments and interventions. Importantly, programs in recreation and nutrition focus on optimizing health and preventing the most common and debilitating diseases currently facing Americans. Health promotion starts with healthy habits and our programs are proactive in improving learning and success in children. With obesity and diabetes reaching epidemic levels in the U.S. and globally, scientists are unraveling the mysteries of factors affecting the newborn as small babies are predestined to experience increased risks of metabolic syndrome including obesity, diabetes and cardiovascular diseases. Improving our Health through research that benefits humans, animals, plants and the environment is one of the critical Grand Challenges for strategic emphasis for years to come.

Focus Areas

Within this grand challenge area, the sub-committee members have identified five foci for this initiative: (1) *One Health: A Systems Biology Approach,* (2) *Foods for Health and Prevention of Disease,* (3) *Ingestive Behavior and Metabolism,* (4) *Wellness through Parks and the Natural Environment* and (5) *Population Growth and Reproductive Rights*. A brief description of each is provided below.

One Health: A Systems Biology Approach

One Health is an overarching theme recognizing the complex links between animal, human, and ecosystem health that are both beneficial and problematic and require investments in basic and

translational research, education and outreach for solutions. The guiding principles for success are those set forth in National Institutes of Health's Roadmap (see https://commonfund.nih.gov/) based on a systems biology approach to integrate the scholarship of multiple disciplines in human and veterinary medicine, agriculture and life sciences, biomedical engineering, computational sciences, genomics and environmental scientists. This integration of scholarship will ensure a safe, abundant and affordable food supply, advance health care for all species and protect our ecosystem, as well as protect society and our environment from biological threats.

The "One Health" initiative at Texas A&M University must include research from individual genes to entire organs, systems and whole organisms. Interdisciplinary teamwork is essential to explore the broad array of intricate and interconnected pathways of communication among genes, molecules, and cells. The goal is to understand how these pathways are integrated in complex organisms, determine how disturbances in these pathways lead to disease and disease resistance, and desired phenotypes that enhance production agriculture, human and animal health, and health of the ecosystem. A central and fundamental principle is that biological processes are governed by expression of genes through transcription of messenger RNAs that translate to proteins to form the "proteome." To understand the proteome, researchers must collaborate to determine, in real time, which cells produce proteins and in what amounts and how interactions among large numbers of individual proteins affect biological functions. This enhances understanding of metabolic components and networks within cells, the "metabolome", that is assessed by technologies to measure local concentrations of carbohydrates, lipids, amino acids, and other metabolites within a single cell or even a specific part of a single cell. The goal is to define metabolic differences between normal and diseased cells or between energetically efficient and inefficient cells with respect to environment, disease, injury or infection. Notably metabolomics reflects the integrated outcome of an active genotype with the environment, a component that includes both diet and physical activity. Diet and the creation of environments conducive to healthy activities engage all aspects of the agricultural enterprise. The realization of expectations of the integration of scholarship from agriculture, physics, chemistry, and engineering to enable scientists to use computers and robotics to separate molecules in solution, read genetic information, visualize three-dimensional shapes of natural molecules such as proteins, macromolecules and image the brain activity in real time. Each of these techniques generates large amounts of data that biologists can appreciate only when it is evaluated using Bioinformatics and Computational Biology that underpin an "information superhighway" that advances biological sciences to solve mysteries associated with differences among individuals in their growth and development, reproductive potential, response to environmental factors and resistance to disease and parasites. Structural Biology is also a key to the development of proteins, peptides, phytonutrients, and other macromolecules or fabricated nanostructures that enhance health and well-being when used as pharmaceuticals.

Foods for Health

Foods for Health (FFH) research examines the complex systemic processes, from consumer choice to biochemical mechanisms that underlie functions of nutrients in plant-and animal based foods that enhance human health and disease prevention. For example, FFH research includes isolation and characterization of naturally occurring compounds to determine their potential human and animal

health benefits. Establishing the health benefits of such compounds *in vitro* and *in vivo* requires research at the cellular level, as well as studies involving animal models, and human intervention studies to unravel mechanisms of action. All of this requires multidisciplinary expertise. Therefore, the success of this research and education plan must integrate broad expertise in horticulture, food science and engineering, nutrition, chemistry, medicine, veterinary medicine, poultry and animal sciences, toxicology, microbiology, biochemistry and economics.

There is growing recognition that bioactive compounds in food play critically important roles in disease prevention in humans. Therefore, the options consumers have and the choices they make determine the nutritional status of the nation. These options and choices are critical to national health goals because healthy diets are strongly linked to longevity and to the prevention of disability, major chronic diseases, and death in the United States.

Producing healthful options and guiding healthful consumer choices depends on a "consumer to farm" rather than a "farm to consumer" approach of which a key component is creation of an informed consumer through effective outreach and K through 12 educational programs. Therefore, a systems-wide approach encompassing multidisciplinary FFH research ranging from pre- and post-harvest production methods to understanding the roles of individual bioactive compounds and whole foods in prevention of disease will be critical to improving our health.

Ingestive Behavior and Metabolism

Food and feed consumption is the fundamental process whereby nourishment is taken into the body. This activity is influenced by a disparate group of variables that include hedonic, social, economic, cultural, psychological, health status and food availability. Comestible items must then be reduced to their metabolically useable forms by physical and chemical processes that can be transported beyond the gut and utilized by the body. Metabolism can be normal, dysfunctional or optimal, with criteria for these designations varying with genetics, gender, ethnicity, physiological age and pre-existing health conditions. Because metabolism occurs in cells across multiple tissues and utilizes gene products and essential nutrients, its regulation requires multiple levels of control including those at the transcriptional, translational, hormonal and neuroendocrine levels. The regulatory processes use multiple interrelated signaling systems integrated at the level of the brain. Characterization of metabolism properly includes evaluation at the transcriptional/translational level, chemical level via metabolomics and proteomics (substrate/product relationships as well as protein "machine" amounts and status), clinical (acute integrated responses) and long-term health outcome level. The emerging field of epigenomics is the study of how environmental factors, nutrition, stress and gender modify structure and expression of genes without affecting the make-up of the genome directly. Epigenetic modifications of the genome adversely impact fetal growth and development and metabolic activity (metabolome) that predisposes one to adult onset of metabolic and inflammatory diseases (e.g., obesity, diabetes, and cardiovascular diseases). The genome can be thought of as a hard drive on a computer and the epigenome is the software that regulates the expression of genes within the genome. For most chronic disease, the long-term health outcomes arise through the integrated and summative effects of daily ingestive choices and their effects on

the epigenome as reflected in the metabolome, a currently underutilized diagonostic for personalized health solutions.

Wellness through Parks and the Natural Environment

Research on wellness through parks and the natural environment examines how public parks, gardens, greenways, and other natural areas contribute to individual and community health. An important direct benefit is in the form of restoration of healthy minds and bodies. The natural environment impacts people's well-being, ability to concentrate, outlook on life, and stress levels. These impacts are well documented through research based on Biophilic Design and attention restoration theory. Findings from this research have led directly to the redesign of hospitals around the world where natural elements have been shown to accelerate the healing process. Likewise, in his recent book, *The Nature Principle*, Richard Louv documented that health professionals are beginning to actually prescribe time in parks and natural areas as a supplement to traditional drugs and counseling methods.

Parks and other natural areas contribute to health by providing inviting places for people to engage in physical activity, including gardening, walking, and bicycling. Research shows that proximity and availability of parks and natural areas is linked to higher rates of physical activity and lower rates of obesity, diabetes, and hypertension. Stated differently, improved health is linked to physical activity which is linked to opportunities in the physical environment. Public parks and trails provide affordable, accessible, safe places and amenities to support active and enjoyable lifestyles for all age groups.

There are also many positive social benefits associated with parks that build family and friendship networks. Some of these social benefits are often realized through programs in parks and other recreational areas. Other social benefits accrue more directly simply because parks and other natural areas are attractive places to visit. Parks contribute to people's well-being by promoting interaction and community, which nurture social support. It also keeps the community engaged in maintaining a healthy environment.

Parks and natural areas contribute to community health by helping to protect drinking water and other aspects of ecosystems on which people rely. There are clear linkages, for example, between the quality of water coming out of catchment areas and the amount of parklands and forest areas. Austin has multiple Edwards Aquifer Recharge Zones designated as a part of their larger system of green infrastructure. These zones are strictly guarded from development as they serve to help filter and purify rainwater as it enters the aquifer. This has direct implications for the health of people in San Antonio who drink this water daily. Rural areas with larger parks and protected areas are particularly critical in sustaining critical ecosystems.

Population Growth and Reproductive Rights

A driving assumption underlying our Grand Challenge charge is that the world's population will grow to 9 billion by 2050. This assumption is likely true is population growth is left unattended. The issue

of population growth centers around family size and reproductive rights which requires a strategy to educate women, both globally and locally, regarding reproductive health, nutrition, quality of life issues for families, ownership and management of land, and management of farms. With improved education of women it has been demonstrated that birth rates decrease which reduces pressure on available resources including food sources and the environment. Importantly, the projected increases in the human population on our planet will stabilize and perhaps decrease in response to improved education and decision making by women of the world. We need a mechanism to recruit and educate more women from developing countries who can become leaders in dealing with these issues within their respective cultures. Replicating the land-grant university system in developing countries will provide an opportunity for promulgating the concept of teaching, research and service to enhance educational experiences in general and to build strengths in agriculture and life sciences and engineering critical to building a strong infrastructure for countries to ensure a safe, abundant and affordable food supply that underpins economic and political stability.

Integration through Translation and Application

The system approach required for solving complex problems is evident, not only in the focus areas, but through the translation and dissemination of new knowledge. By strategically and collaboratively working across disciplines, we are able to determine appropriate direction in curricular revision and assessment measures. Formal and informal education, degree programs, certificates, and continuing education efforts will provide broader impacts and implications for the public. Plant and animal biotechnology will be enhanced by new discoveries and practices to drive enterprises and economic growth. Changes in food selection and healthy lifestyles can reduce the cost of healthcare. These interrelationships would promote strategic initiatives within the college, university, and external stakeholders.

In order to realize the potential to impact the "Grand Challenge To Improve Our Health" it is essential that we capitalize on expertise from many disciplines. There are many centers and institutes at Texas A&M University that address issues critical to the overall goals of faculties who can contribute to this Grand Challenge. These include the Institute for Plant Genomics and Biotechnology, the Center for Animal Biotechnology and Genomics, the Vegetable and Fruit Improvement Center, the Institute for Obesity Research and Program Evaluation, and the Agrilife Extension Service; however, there has been and is a more important challenge for success on the College Station campus. The challenge is to break down barriers that allow creation and maintenance of outstanding core facilities that serve the research needs of all faculties across our Texas A&M University campus through support from all academic units. Researchers at Texas A&M University often require access to resources, technical expertise or pieces of equipment that no individual investigator can acquire. This is due to the rapid evolution of knowledge, techniques and associated equipment to address key aspects of scientific research. The solution is a mechanism to provide access to outstanding Core Facilities that allow individuals or teams of scientists to keep abreast of both technical and intellectual advances in their science and to capitalize on synergies created through inter-disciplinary and multi-disciplinary research. There is a clear need to have discussion across the various grand challenge groups to capture and focus on the many common issues of concern in meeting the grand challenges.

Outcomes/Goals

1. COALS/TAMU as the key player in development and implementation of plans to improve people's health – based on reputation, visibility, demonstrated impacts in this area.

2. COALS/TAMU as the principal partner in preparation and submission of multimillion dollar grants to address key issues related to food consumption habits, environment, exercise, and health, etc… Capitalize on all funding streams – NIH, NSF, DOE, USDA, private sources, excellence fund (student fees) and so forth to support excellence in teaching, research and service.
3. Expanded expertise in critical areas relevant to improving health with cross disciplinary degrees and research foci.

4. Support current highly productive faculty to enhance their programs and retain productive faculties and their programs.

Strategic Needs to Accomplish Outcomes and Goals

1. Core facilities accessible to COALS and TAMU researchers are needed. This requires planning for the appropriate Core Facilities and identification of required research space, personnel to interface with users and the acquisition of instrumentation for the core facilities, as well as clinical laboratory space. We have impoverished resources and facilities in general. We are not competitive because we lack equipment and computational/bioinformatics for data analysis. The state and university needs a long term commitment to building a strong infrastructure for research that supports excellence from within and attracts new talents. We suggest creation of a task force comprised of individuals from each college of the College Station campus to study and prioritize our needs.

2. Mechanisms for collaborations across colleges and universities should be examined. We have the potential to lead an interdisciplinary effort regarding wellness/nature principles, providing science-based demonstration of value. We must include economics, education, marketing, and behavioral change to understand the decision making process. Collaboration with the Center for Health Systems & Design in the Colleges of Architecture and Medicine could be a starting place. This Center is interdisciplinary and its programs focuses on health facility planning and design with research interests ranging from effects of stress on patients' health and wellbeing, to the design of healing environments for neonatal patients, children, the elderly, people living in the Texas Colonias, and AIDS patients.

3. COALS needs not only to attract new talent, but a strong effort must be made to invest in the development and empowerment of existing personnel through seed monies and internally funded proposals to enhance collaborations and innovations. Professional development and mentoring are key components to faculty retention and competitiveness in extramural funding.

4. Engagement at various levels of the college should be enhanced. Hiring of technicians, extension faculty, post-doctoral fellows, graduate students, and undergraduate students is essential for continuing and expanding successful research, teaching, and outreach programs in this area. This should include funding to support undergraduate student placement in labs as "work study" to create a community of engagement and skill development as a pipeline for graduate school and job placement for underrepresented populations. Interdisciplinary courses, seminars, and mentoring programs can engage students in solving complex problems related to our grand challenges.

5. A systematic process for evaluation of administrative functions is needed to assist with identification of opportunities for collaborations and efficiencies in project development and implementation. We must capture synergy administratively and learn from successful programs in the US (e.g., North Carolina State University, University of Florida, University of Missouri, MIT, Scripts Research Institute and the University of California). Grant support to develop interdisciplinary teams to work on the complex problems associated with health issues should be a priority.

6. Emphasis on the individual scientists and their creativity is a prerequisite for strong interdisciplinary teams. This can be accomplished by providing support, e.g., endowed chairs and professorships for excellent scientists who are now at Texas A&M University. We need a community of scholars in the "Improve Our Health" area. COALS communications could develop video clips linked to the grand challenge areas with faculty expertise highlighted. Investigators could talk about their research programs, research questions, and how their research fits into these challenges. Strong research teams evolve in response to interactions among productive individual faculties that recognize and capitalize on synergies created through collaborations. The productive individual faculty member is the one who will be welcomed into such teams. Monthly brown bag sessions or seminars could enhance further communication and collaborations.

Chapter 6. Subcommittee Report on Grand Challenge: Protecting our Environment

Subcommittee Members: Astrid Volder, Jacqueline Aitkenhead-Peterson, Spencer Behmer, Thomas Lacher, Clyde Munster, Richard Woodward, Joshua Yuan; **Facilitator:** David Reed

Introduction

From preserving biodiversity to sustainable stewardship of land and water resources in the face of global change, the College of Agriculture and Life Sciences at Texas A&M University is dedicated to protecting our environment. The college takes a leadership role in protecting our environment by leading the nation in research into the functioning of ecosystems altered by humans, either through urbanization or agriculture, and those (semi) natural systems threatened by climatic change and other anthropogenic change. Our faculty and students will lead the way in improving our understanding of ecosystem functioning and developing sustainable solutions to changes in land use and adaptation to global change. Global change is a pressing and truly global problem and affects the climate, carbon cycle, nutrient and water cycles and all other processes depending on these cycles. Global change occurs largely due to the impacts of agriculture and urban pressures on natural ecosystems. We are moving into a new era where improved management of existing agricultural landscapes is critical to protection of our environment. Forefront issues are soil degradation and loss, nutrient pollution from fertilizers and animal waste, and water consumption, as well as their effects on ecosystem services, invasive species and biodiversity. Many of these same issues exist in urban environments, too, where air and water pollution and runoff from impervious surfaces harm stream health and impact water supplies. We will need to develop strategies to project the rate and magnitude of global change and its ensuing impacts and then develop tactics to adapt, or better, mitigate the causes of global change.

At very broad scales, climate change is expected to alter species distributions, cause more frequent weather-related disturbance events, shift rainfall patterns that drive water supplies and stream hydrographs, and accelerate sea level rise that will lead to issues with saltwater intrusion and coastal flooding. Changes in seasonal precipitation patterns, annual rainfall amounts and rising temperatures will significantly impact agriculture and the humans depending on it. Both seasonal rainfall and temperature patterns are predicted to become more variable with a higher incidence of extreme rainfall events as well as more prolonged drought periods, coupled with a greater incidence of regionally extreme high temperatures. How changes in climate and climatic stability will affect crop productivity (food security) and ecosystem services (e.g., nutrient cycling, climate mitigation, pollination) will be topics of increasing importance when designing sustainable solutions to support the future world population.

Land use change, which includes conversion of natural lands to cropland, urban, and peri-urban regions has a detrimental effect on ecosystem services, biodiversity and the movement of species and is a major contributor to CO_2 release into the atmosphere. Estimates suggest that land use

change contributes a net 1.6 Gt carbon per year to the atmosphere. Habitat loss, ecosystem degradation, and fragmentation affect carbon, water and nutrient cycling, have devastating effects on biodiversity, and are the greatest cause of extinction of terrestrial species. Thus, the committee identified land use change as another major area under the global change umbrella that highlights the importance of sustainable development and the restoration of degraded landscapes to improve ecosystem services.

Focus Areas

Within the grand challenge area, the sub-committee members identified three potential focus areas, all can be placed under an overarching theme of "global change" in urban, natural and agricultural settings. The three focus areas are: (1) *Water,* (2) *Urbanization & Land Use Change* and (3) *Invasive species/Biodiversity*. A brief description of each is provided below.

Water

In a comprehensive report, the US Defense Intelligence Agency concluded that access to high quality fresh water is not just an agricultural or human health issue, but a major peace and security issue (ICA 2012-08). Lack of available water will lead to major food insecurity as the world population increases along it exponential track and exerts pressure on precious water resources. The FAO estimates that in a world without climate change an 11% increase in irrigation water usage by 2050 would be necessary to support the estimated 9 billion people at that time (FAO Report 36, 2011). By 2025, 1.8 billion people are expected to be living in countries or regions with "absolute" water scarcity (<500 m^3 per year per capita), and two-thirds of the world population could be under "stress" conditions. Climate change will impact the extent and productivity of both irrigated and rain fed agriculture across the globe. Reductions in river runoff and aquifer recharge will affect water availability in regions that are already water-stressed while highly populated deltas are at risk from a combination of reduced inflows, increased salinity and rising sea levels. Everywhere, rising temperatures will translate into increased crop water demand. Food security of a predominantly urban population is at risk from water-related impacts linked primarily to climate variability. Pollution of potable water sources by sewage,

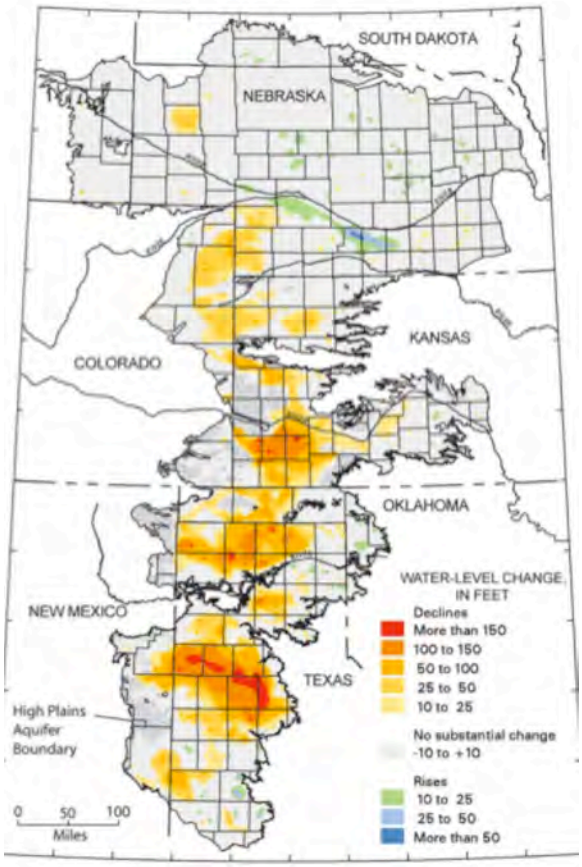

Figure (above). Ogallala aquifer water level change 1950 – 2005. Source: USGCRP (2009) Global Climate Change Impacts in the United States

pesticides, fertilizer runoff and other anthropogenic contaminants further threatens access to safe drinking water and increases the tension between water needs of people, agriculture, nature, and industry (e.g., water use for fracking). Adapting to global change can provide impetus for developing sustainable towns and cities, agricultural cultivation methods and cultivars that improve resource use efficiency as well as the development of best management practices to reduce point and non-point sources of pollutants.

Urbanization & Land Use Change

The world urban population is expected to increase by 72% from 3.6 billion in 2011 to 6.3 billion in 2050 (UN 2011) compared to a total population increase from 7 billion in 2011 to 9.3 billion in 2050 (33% increase). Most of this growth will be in mega cities (>10 million inhabitants). Issues of food security may become even more important for people living in these urban areas, particularly those cities located in developing countries. Conversion of farmland and wild lands to urban land increase conflicts between urban people and nature, while decreasing the ability of ecosystems to provide essential ecosystem services (e.g., food, water purification, nutrient cycling, air pollution removal, carbon sequestration). In addition, the presence of large urban and/or agricultural centers often leads to degraded environments in the greater surroundings. Restoring degraded landscapes will be an increasingly important topic as population pressures increase. Research that leads to a better understanding and valuation of human-dominated ecosystems and the services they provide, can inform sustainable development of urban areas that will be healthy environments for generations to come.

Invasive species / Biodiversity

Invasive species of any group can disturb ecosystems through rapidly spreading disease vectors (e.g., Chestnut Blight, Dutch elm disease, Emerald Ash Borer, Redbay Ambrosia Beetle), by displacing native species (e.g., Kudzu, fire ants, Asian carp), by clogging waterways (e.g., *Arundo donax*), altering nutrient cycling in ecosystems (e.g., earthworms, N_2-fixing invasive plants), or causing physical damage (e.g., feral hogs) or any combination of these impacts. In many cases invasive species affect multiple ecosystem processes, thereby modifying the environment to exclude native species and promote their own success and potentially pave the way for other invasive species to establish. Often invasions lead to irreversible changes in ecosystem function, reduced biodiversity and reduced provisioning of ecosystem services. The US Fish and Wildlife service estimates that invasive species cost the United States more than $120 billion in damages and control strategies every year. Another related issue of increasing importance is the appearance of herbicide resistant weeds due to interbreeding of weeds and GM modified crops causing the emergence of superweeds, strongly reducing crop production in affected areas.

Biodiversity is essential for ecological community resistance to invasive species, enhances resilience to disturbance and directly and indirectly offers a wide range of benefits to humankind. This includes diversity that ranges from genetic diversity within populations of a single species, which enhances the capacity of species to respond to disturbance and climatic change, to diversity of full ecosystems, which is critical for ecological processes at a regional and international level. The 2011-2020 decade was declared the UN Decade for Biodiversity. Resilience is a critical characteristic of healthy ecosystems, by identifying underlying interactions among ecosystem components, scientists will better understand the mechanisms that produce important ecological services, and thus more accurately calculate the intended outcomes and feasibility of management actions. Texas A&M University is the only North American institution of higher education in the IUCN Red List Partnership, which supports the global initiatives of IUCN in assessing extinction risk. The College of Agriculture and Life Sciences is particularly well positioned as a leader in biodiversity research as it already hosts the Applied Biodiversity Science IGERT program. The ABS program has created a strong interdisciplinary group of faculty and graduate students whose studies range from relationships between species diversity to social and economic processes that affect and sustain ecosystem functioning. Indeed, the university has made a commitment to maintaining the ABS Program through a Tier I grant, and the expectation of the National Science Foundation is that IGERT programs become institutionalized.

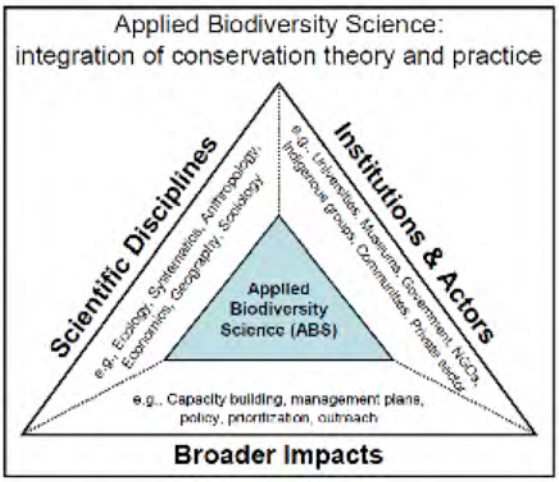

Figure (above). TAMU-ABS IGERT organizational and research framework.

Integration through Translation and Application

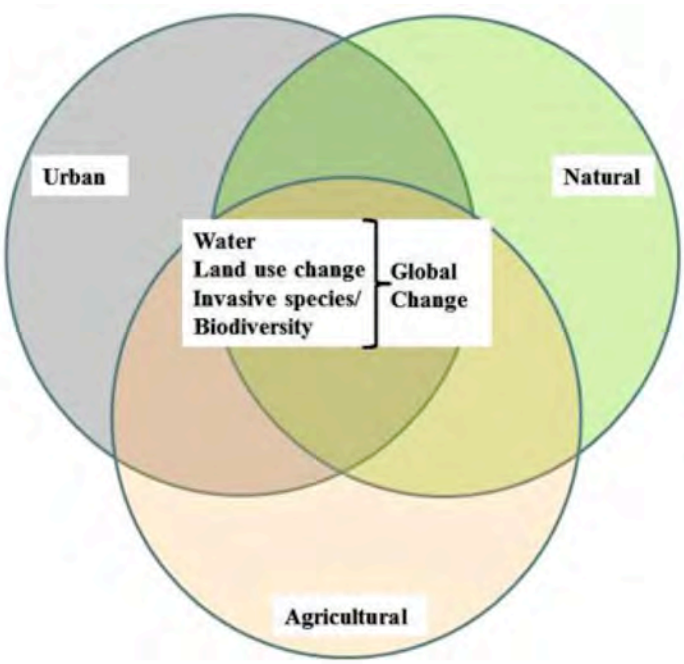

Figure (right). Overall framework of the 3 identified focus areas interacting with agricultural, urban and natural systems.

Capacity and strengths

- Existing Applied Biodiversity Science (ABS) IGERT
    - Expand with environment and sustainability component
    - Potential blueprint for new IGERT
- Interdisciplinary research program in Ecology and Evolutionary Biology (EEB) provides collaborative platform and capacity to lead efforts in this area
- Extensive international expertise within college, for example through the Borlaug Center and USAID Higher Education Solutions Network.
- Experienced teams already present within the Texas Water Resources Institute (TWRI), Institute for Renewable Natural Resources (IRNR) and Water Management and Hydrologic Science Program
- Large diversity of ecosystems and existence of strong water and temperature gradients within Texas (ample research opportunities)
- Land grant university tradition places strong emphasis on extension allowing for excellent avenue of bringing applied research results and management solutions to a wide range of stakeholders
- Large number of faculty working on water related issues, some on climate change. Overall diversity of research skills in college provides experts in almost any critical issue facing the environment, for example
    - Stream health and restoration
    - Marine dead zones
    - Invasive species
    - Habitat fragmentation
    - Biodiversity losses
    - Saltwater intrusion
    - Pollution
    - Wetland ecology and restoration
    - Deforestation and reduced forest health
    - Plant and animal disease
    - Seasonal drought and impacts of rising temperatures

Outcomes and Goals

- Broad financial support from federal, state and private sources (e.g., foundations such as the East Foundation)

- Become competitive for large federal grants within the focus areas

- New IGERT, for example:

    - Sustainable water and land management across urban and natural landscapes

        - Biological consequences of climate change

        - Sustainable water management

        - Drought impacts and mitigation

        - Impacts and mitigation of land use change

        - Management strategies to improve ecosystem function

    - Such an IGERT would need to include aspects related to economics, policy, conflict resolution, education/extension, recognizing the tradeoffs between some of the grand challenges (i.e., protecting our environment versus feeding our world (intensified agriculture) versus grow our economy) as well as recognize tradeoffs in land use. For example, land sharing urbanization and agriculture generally reduces biodiversity whereas land sparing through creating bioreserves will help preserve biodiversity, but not provide many provisioning and economic ecosystem services.

- A research center for global change research in collaboration with the Texas Center for Climate Studies in Geosciences where the new research center would focus on the biological/soils/water and nutrient cycling components of global change

- A center for "sustainable solutions", e.g., joined with Dept. of Landscape Architecture and Urban Development focusing on green urban development, innovative sustainable agriculture, bioenergy

- Establish an NSF-LTER site in Texas focused on "managed ecosystems" using the rainfall gradient that exists across Texas longitudes and/or using some of the river systems/watershed as a long-term study site along a range of land use types.

Strategic Needs to Accomplish Outcomes and Goals

- Use seed money from college to acquire state funding to tackle water related problems, then use the increased research capacity to acquire federal funds and IGERT funding
- A platform for faculty to meet and find other faculty with similar environmental oriented research interests
- Improved research infrastructure to support and strengthen current research
- Faculty than can lead modeling efforts to tie current faculty research together
- A faculty team initiative with seed money/staff support to provide administrative services and free up faculty time to develop large federal grant applications
- Internationally recognized leader(s) in climate change/sustainability research needed to attract level of funding necessary to support a center
- Connections with private foundations to clarify how this research will meet the need of private landowners
- Increased research strength into responses of animals to climate and land use change (e.g., range shifts in responses to increased climate variability, production efficiency of cattle)

Chapter 7. College Grand Challenge Implementation Plan

1. **Collectively, the College's Grand Challenge planning effort resulted** in the 24 sub-themes identified in Figure 3. Many of these sub-themes had specific initiatives identified by the faculty working groups. Others did not and would need such programmatic goals to be developed in order for the sub-theme to progress. This list of 24 sub-themes will be vetted periodically to make sure it remains appropriate and consistent with the institution's overall vision and activities.

2. **The unification committee further refined** that 24 sub-theme vision into six cross-cutting, unifying themes. These unifying themes will be used as a framework for summits during 2014 in which faculty networking, team building and project development can occur. These projects can and should reflect the sub-themes but also serve to keep the Grand Challenges interwoven. These six unifying themes also will be used as an organizational framework with which to organize efforts, people and interactions with AgriLife agencies and other TAMU colleges.

3. **A College Grand Challenge Coordination Council will be constituted in spring 2014** to oversee, coordinate and advise the Dean on the activities, organization and progress toward the five Grand Challenges. This Council will be appointed by the Dean and composed of two department heads, two faculty senators and two College members of the TAMU Council of Principal Investigators. No single person can fill two of these roles and thereby occupy more than one seat on the council. The Research Associate Dean will be the convener of this council. Its purpose will be advisory to the Dean. This Council will meet at least twice each year and report to the Dean.

4. **An annual summary of activities and progress toward sub-theme goals and plans** for the coming year will be prepared by the Council each year. The overall Grand Challenge sub-themes structure will be subject to modification on an annual basis as needed but will be formally reviewed and updated every three years.

5. **Based on the College-wide planning activities,** the Grand Challenge faculty groups and unification committee developed the following list of common needs and action items for each. They are generally organized into two areas: faculty awareness and engagement, and support for interdisciplinary initiatives. Sub-categories of these needs and action items for each are provided below.

Figure 3

Faculty Awareness and Engagement

- *Faculty Networking –*

  Faculty may be well-versed in the faculty, staff, programmatic and facility resources in their own disciplines, but not what is available in others. They need to be aware of potential collaborators as well as opportunities in terms of funders, funding programs and requests for proposals. Faculty members also need to be aware of what efforts/projects are already ongoing at TAMU and how they might contribute to such projects with their own expertise or by merging complimentary programs. This indicates that communication is critical in terms of a faculty expertise database, inventory of programs/projects, and regular update on opportunities.

  - ➢ Action Items

    - ✓ Assemble open faculty working groups for each Grand Challenge with sub-groups for each big idea generated

- ✓ Create inventory (searchable database) of faculty expertise across College/AgriLife

- ✓ Create inventory (searchable database) of ongoing programs relevant to each Grand Challenge

- ✓ Create mechanism to advertise relevant funding and other opportunities (may already exist in other form) to working groups faculty (email, website)

- ✓ Post the above information on the College Grand Challenge website

- *Faculty Expertise –*

  Effective and competitive projects require expertise in key areas and a critical mass of that expertise in terms of numbers of people. It is essential that gaps in our expertise relative to the Grand Challenge initiatives be identified and then filled as new hires and redirections of existing faculty occur. This may often require that Departments work together or that interdisciplinary organizations such as institutes and centers be the home for such expertise.

  - ➢ Action Items

    - ✓ Departments consider Grand Challenge white papers and faculty working group initiatives in formulating requests for new positions

    - ✓ Faculty working groups or similar interdisciplinary faculty groups can suggest expertise/position needs directly to administration

- *Faculty Recognition/Success (mentoring, culture, education, service/outreach) –*

  Addressing the large and complex Grand Challenges will require an interdisciplinary team approach that will cause people to work across departmental lines. Working on large teams may also be contrary to the advancement of a tenure-track new assistant professor as such large projects usually do not have a rate of output evidence to make a successful tenure case. Because of these and other related issues, our College will need to foster a culture in which interdisciplinary efforts and teamwork are valued and rewarded in the same way that more disciplinary/departmental-centric achievements are. We will also need to appropriately support and mentor faculty involved in these types of large or interdisciplinary projects.

  - ➢ Action Items

    - ✓ Recognize the value of interdisciplinary activities in College promotion and tenure guidelines and encourage departments to do likewise

- ✓ Include consideration of interdisciplinary activities in faculty mentoring activities at the department and college levels

- ✓ Continue the Dean's team award

- Communications

  The teams needed to address the Grand Challenges will need to be formed from faculty that either do not yet know each other or are from different departments. They may be from other colleges or institutions. They will likely have different spheres of influence and opportunity. All of this is to say that communication will be critical to getting them together and making sure they can function and access all the opportunities available to them. Networking activities as well as updates of funding possibilities and ongoing activities are just two internal benefits but communicating our impact and potential to the outside world will be needed too.

  - ➢ Action Items

    - ✓ Populate and maintain the Grand Challenge site and pages on the College website. This will contain or link to the inventory of Grand Challenge projects as well as the faculty networking resources like the inventory of faculty expertise, ongoing projects and funding/program opportunities.

    - ✓ Produce an annual report on progress and impact toward the Grand Challenges to be used in external relations, development and internal assessment.

Support for Interdisciplinary Initiatives

- *Seed Funding-*

  New ideas and new relationships between disciplines often don't develop by themselves and need some seed funding to stimulate interaction or to generate some trial runs of results. This funding can come in many forms such as travel grants to meet with potential funders, graduate student funding or operating funds.

  - ➢ Action Items

    - ✓ Partner with AgriLife Research to establish a seed funding mechanism for faculty working group initiatives

- *Proposal Development*

  Interdisciplinary projects tend to be large and complex and, therefore, writing proposals for such efforts are likewise time-consuming and complex. Having proposal development assistance/support is critical to attracting faculty to team initiatives. Faculty are already too fully occupied with their individual, disciplinary proposals to navigate the complexities and magnitude of additional ones.

  - Action Items

    - ✓ Partner with AgriLife Research and Vice President of Research to provide support for proposal development in the form of proposal writers or funding to out-source/contract such services

    - ✓ Work with AgriLife Research and Vice President for Research to facilitate large research efforts and activities

- *Research Infrastructure*

  Interdisciplinary solutions to the Grand Challenges will depend on a base of strong disciplinary programs. These depend on a well-equipped, staffed and maintained infrastructure. In partnership with the University and AgriLife agencies, the College needs to assure access to core research and teaching facilities with the latest technologies and with appropriate levels of financial underwriting. There also needs to be solid support at the departmental level for the faculty member's disciplinary activities.

  - Action Items

    - ✓ Partner with AgriLife Research and Vice President for Research to inventory core facilities, equipment and capabilities in the form of a searchable database

    - ✓ Partner with AgriLife Research and Vice President for Research to develop a strategic/operational plan for improving, maintaining and expanding core lab and related service facilities in response to faculty working group initiatives and departmental needs.

    - ✓ Establish a faculty and/or department head-based infrastructure advisory committee that advises AgriLife (and Vice President for Research) on needs.

- *External Partners*

  Just like the Grand Challenges are too large to be solved by one discipline alone, they are too large and complex to be solved or funded by one institution alone. Our efforts will

require collaborations and funding from external partners such as governments, corporations, other universities, foundations, municipalities and non-profit organizations. Many of these may be new to us as partners and will therefore need special attention as we learn each other's customs, processes and expectations.

- Action Items

  - ✓ Once key challenge initiatives are identified by faculty groups and administration, engage AgriLife Corporate Relations and A&M Foundation to identify and foster relationships with and support from industry partners and stakeholders.

  - ✓ Once key challenge initiatives are identified by faculty groups and administration, work with TAMUS agency partners and TAMU to secure State and Federal support and partnerships.

- Interdisciplinary Support

The interdisciplinary nature of Grand Challenge solutions will require support mechanisms and resources outside of the normal disciplinary departments. Departments are the functional units of the College's operations but Grand Challenge financial, personnel, programming and facility issues often transcend departments and therefore need a management system that recognizes and accounts for the many concerns and needs involved. Likewise, many of the administrative tasks for these interdisciplinary activities often are outside the authority of any one department, so mechanisms are needed to efficiently and effectively complete them.

- Action Items

  - ✓ Assemble/recruit competitive teams to address needs and pursue opportunities

  - ✓ Review and revise departmental and college mentoring and advancement programs so they properly reflect the value of interdisciplinary achievements.

  - ✓ Create a Grand Challenge Coordination Committee/Council that ensures progress, communication and coordination of each and between Grand Challenge faculty groups. This Council may also have additional support functions for the various challenge initiatives (oversight of seed funds, website, etc.).