



Water Programs

Texas A&M University System

<h3>Universities</h3> <ul style="list-style-type: none">• Texas A&M University• Prairie View A&M University• Tarleton State University• Texas A&M International University• Texas A&M University-Corpus Christi• Texas A&M University-Kingsville• West Texas A&M University• Texas A&M University-Commerce• Texas A&M University-Texarkana• Texas A&M University-Central Texas• Texas A&M University-San Antonio	<h3>Agencies</h3> <ul style="list-style-type: none">• Texas A&M AgriLife Research• Texas A&M Engineering Experiment Station• Texas A&M AgriLife Extension Service• Texas A&M Forest Service• Texas A&M Engineering Extension Service• Texas A&M Transportation Institute• Texas A&M Veterinary Medical Diagnostic Laboratory
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 Water Programs



Topics

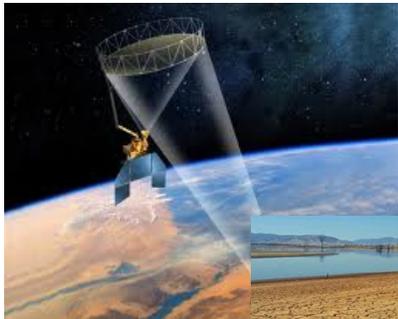
- Texas Water Observatory
- Drought Atlas and Streamflow Simulation
- Water/Energy/Food Nexus Initiative
- Overview of additional water programs and resource material

 Water Programs



Texas Water Observatory: Our Capacity &.. Building!

Water Network, Monitoring, Data Portal, Process Understanding, Modeling, Analyses and Assessment



Binayak P. Mohanty
Regents professor and
COALS Chair in Hydrologic Engineering and Sciences
Texas A&M University



Water Programs

Texas Water Observatory

A Four Prong Initiative

- **Observatory Network**
 - Establishing a series of real-time and near-real time sensor networks in critical zone across Texas monitoring various surface/subsurface water parameters and fluxes (physical, chemical, biological) in various land use land cover, climatic gradient, erosional/depositional environment. It will be supplemented by air-/ space-based remote sensing platforms
- **Data Portal**
 - web-based access portal, real-time web query, data retrieval, normalization, analysis and interpretation. Water related data would include, but not be limited to temperature, precipitation, humidity, evaporation, groundwater and surface discharge, soil moisture, water demand, water supply, water use, and water quality, among others.
- **Modeling**
 - The Water Observatory would integrate surface and groundwater hydrology and decision-making modeling; apply, test and refine existing models; develop modeling software and provide technical assistance on problems related to models
- **Analyses and Assessment**
 - Application of these Water Observatory models for decision makers would provide critical data on climate, surface and groundwater resources, water quality, and threats to water supplies.

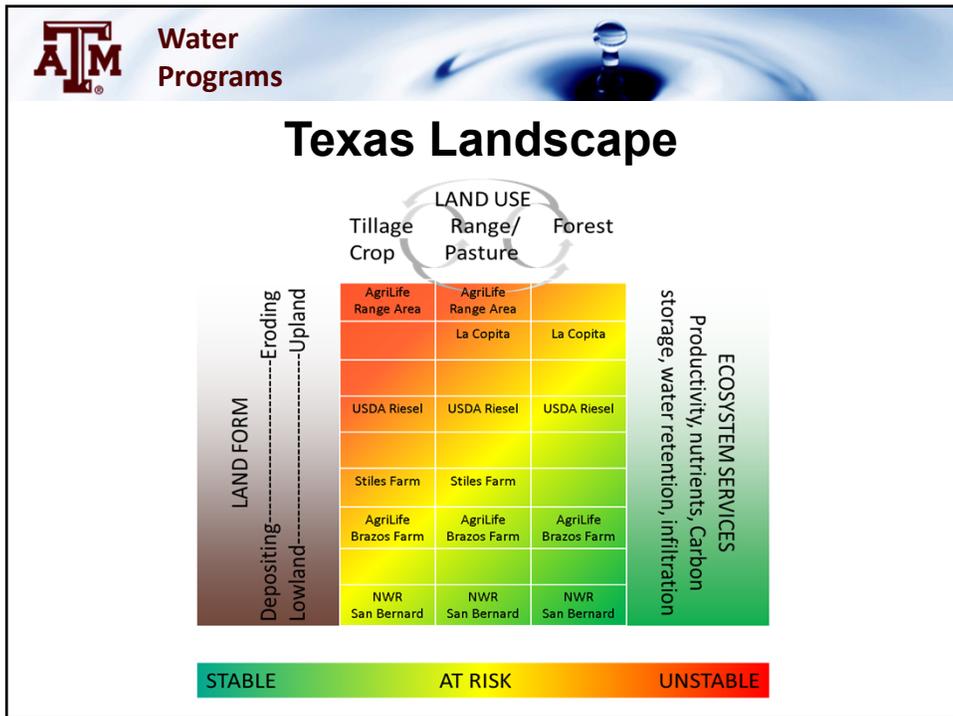
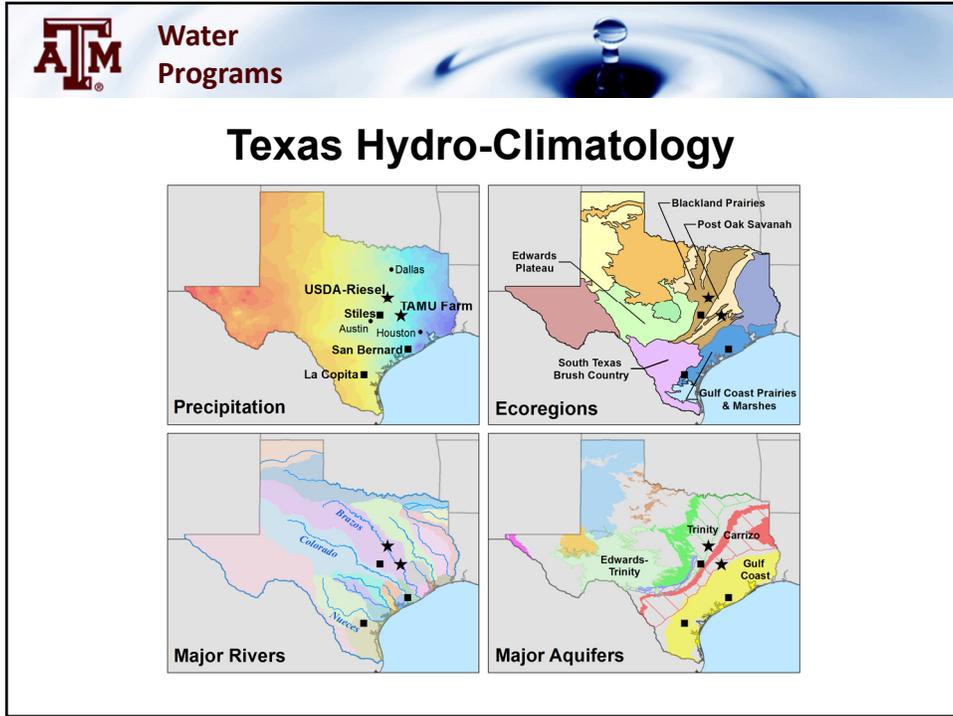


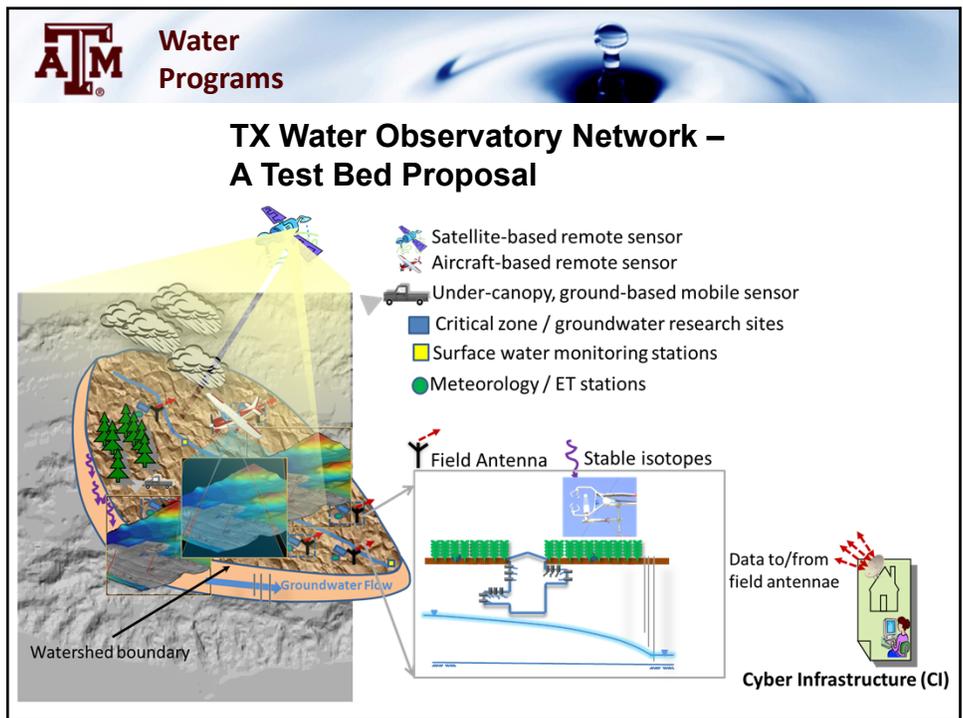
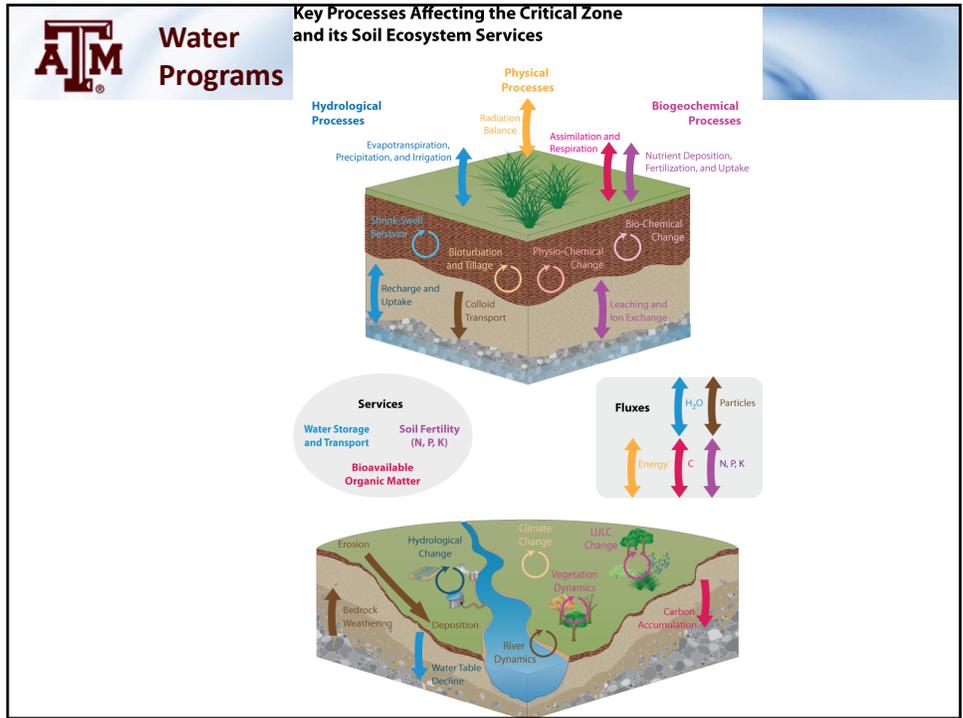
Water Programs

Texas Water Observatory

A Four Prong Initiative

- **Interested/Participating Texas A&M Colleges and Departments**
 - **College of Agriculture and Life Sciences**
 - Biological and Agricultural Engineering
 - Ecosystems Science and Management
 - Soil and Crop Sciences
 - Wildlife Fisheries Sciences
 - Recreation, Park, and Tourism Sciences
 - Agricultural Economics
 - **College of Geosciences**
 - Geography
 - Geology and Geophysics
 - Atmospheric Sciences
 - Oceanography
 - Water Management and Hydrologic Sciences (Interdisciplinary program)
 - **College of Engineering**
 - Civil Engineering







ATM Water Programs

DROUGHT MODELING AND ATLAS, AND STREAMFLOW SIMULATION

Department of Biological and Agricultural Engineering

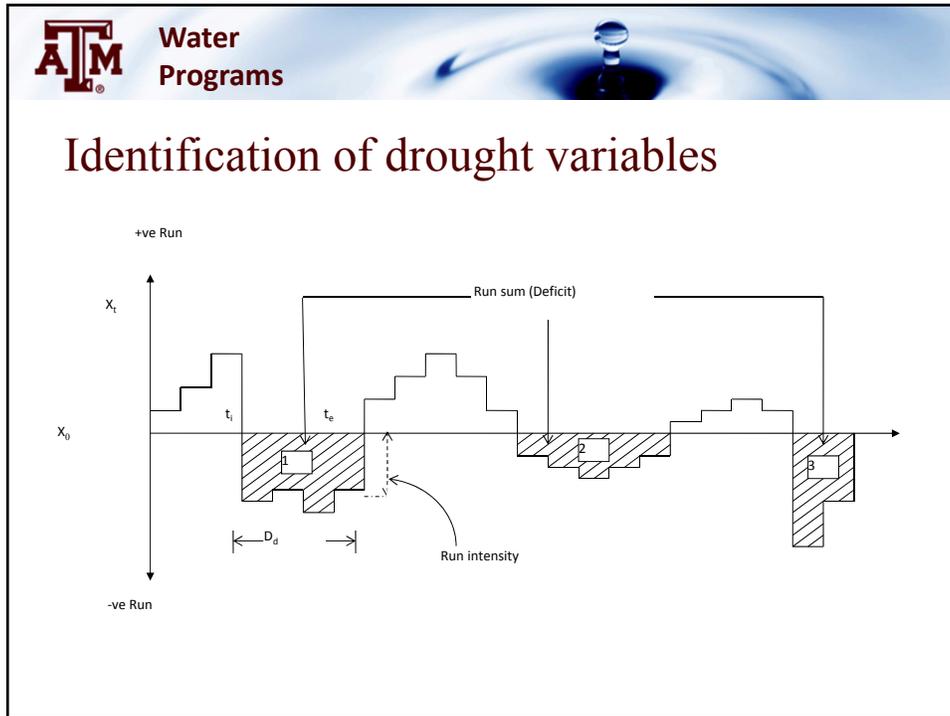
Vijay P. Singh



ATM Water Programs

Drought Definition

- 1. Meteorological drought** is defined as a lack of precipitation over a region for a period of time.
- 2. Hydrologic drought** is related to inadequate surface and subsurface water resources for established water uses of a given water resources management system.
- 3. Agricultural drought** refers to declining soil moisture and consequent crop failure.
- 4. Socio-economic drought** is associated with failure of water resources systems to meet water demands, thus associating droughts with supply of and demand for an economic good.

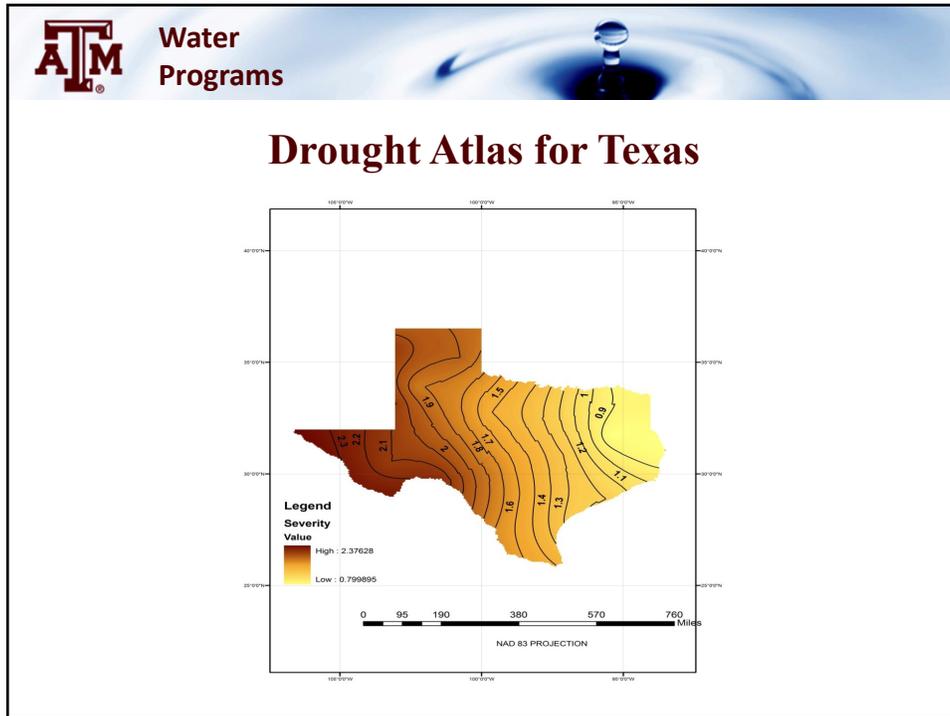


ATM Water Programs

Drought Modeling

Modeling Tools

- Entropy theory
- Copula theory
- Combined entropy-copula theory



ATM Water Programs

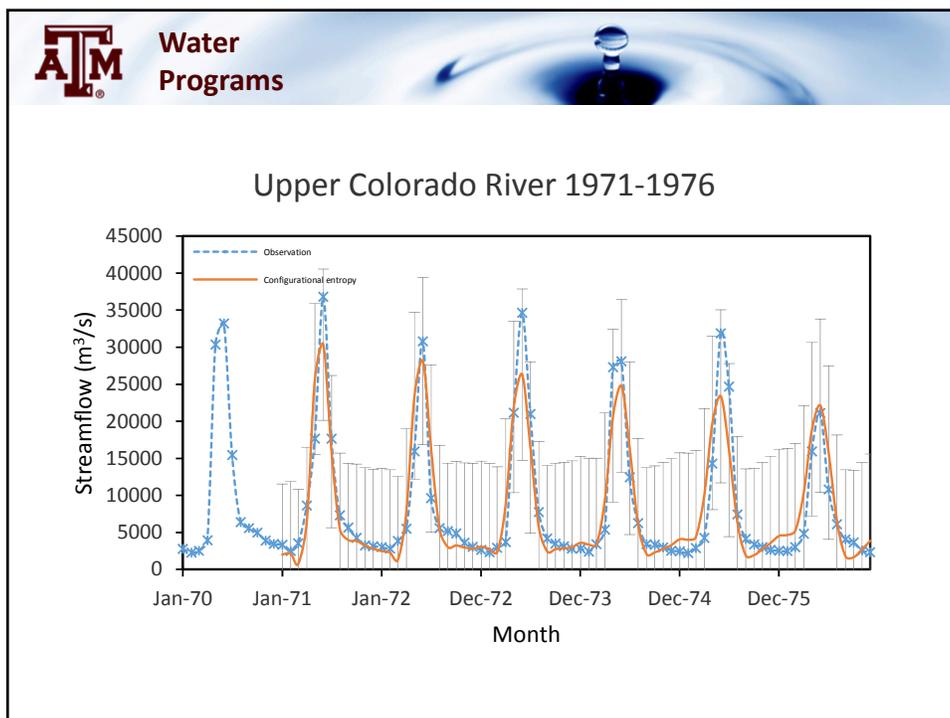
Streamflow Simulation

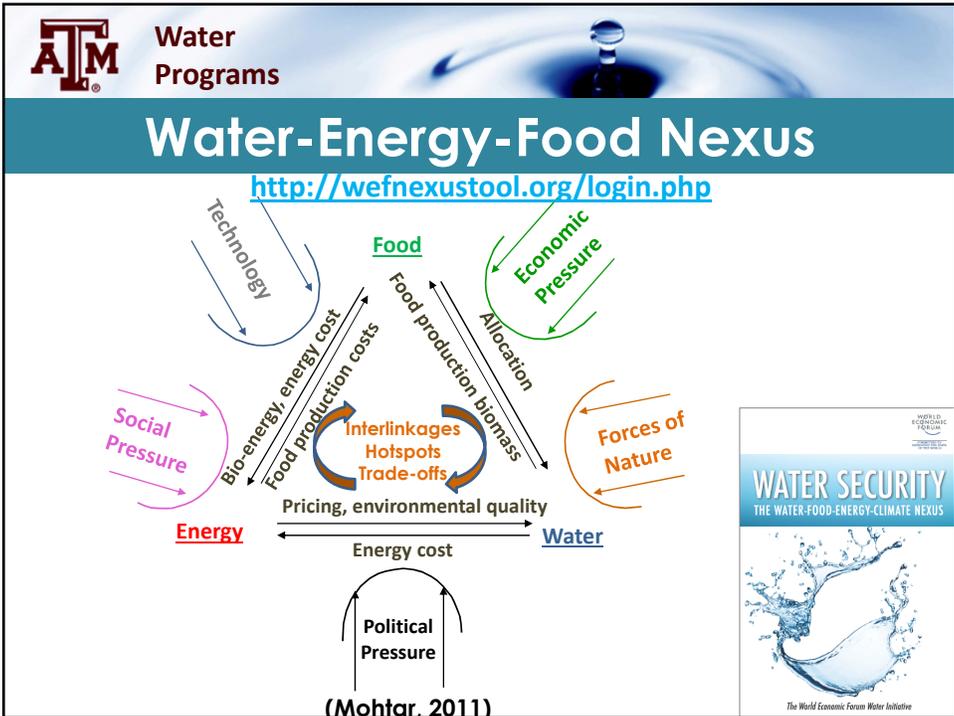
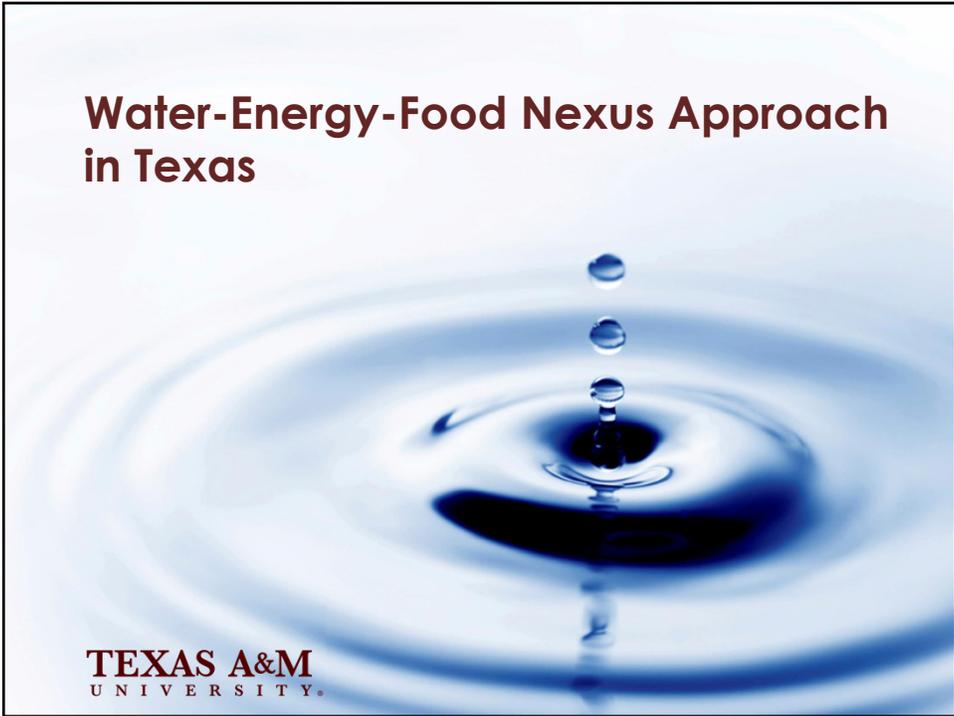
1. Types of Simulation
 - a. Single site simulation
 - b. Two-site simulation
 - c. Multiple site simulation
2. Methods of Simulation and Forecasting
 - a. Entropy theory
 - b. Copula theory
 - c. Combined entropy-copula theory

ATM Water Programs

Streamflow Forecasting

1. Types of Forecasting
 - a. Univariate forecasting
 - b. Multi-variate forecasting
2. Methods of Forecasting
 - a. Burg entropy spectral analysis
 - b. Configurational entropy spectral analysis
 - c. Relative entropy spectral analysis







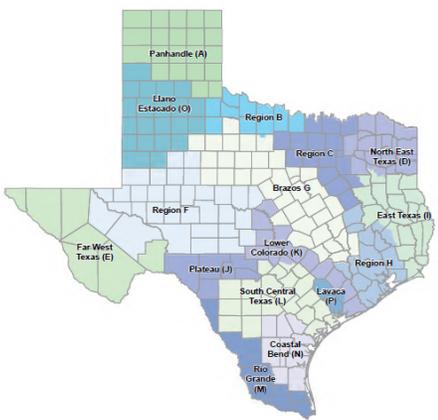

TAMU Water-Energy-Food Nexus Initiative

1. Create an **integrated** multidisciplinary **platform** to address GRAND CHALLENGES: Water Security, Food Security, Energy Security, etc.
2. Identify and respond to national and global opportunities in **research, education, outreach,** and **policy** implementation from **private** and **public** sources




Water Gap & WEF Nexus in Texas

The 16 regional water planning groups



(Texas State Water Plan 2012)

Case Studies

- Fracking activity scenarios
- Urban Agriculture in San Antonio
- Lubbock: Water Demand-Supply
- Groundwater-Agriculture-Fracking
- Aquifer Recharge in Region J
- Dynamic Water Management



Holistic yet localized solutions
to bridge the overall water gap



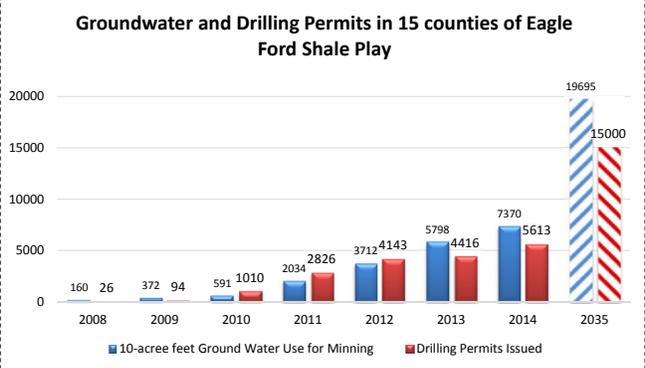

Water-Energy-Transportation Nexus

Scope: Demonstrate a comprehensive assessment of different scenarios of **Energy Development**, specifically, the impacts on the **Transportation** and **Water** sectors in Texas.

Goal: Quantify the *interrelations* and *trade-offs* between the **water**, **energy**, and **transportation** sectors under different scenarios.

Scenario Outputs:

- *Economic Indicators**
- Added value to economy
- Energy production
- Infrastructural deterioration
- *Social Indicators**
- Job Creation
- Traffic
- Health Impact
- *Environmental Indicators**
- Water Need
- Water Consumed
- Water Degradation
- Soil Degradation
- GHG Emissions
- Air Pollution



Year	10-acre feet Ground Water Use for Mining	Drilling Permits Issued
2008	160	26
2009	372	94
2010	591	1010
2011	2034	2826
2012	3712	4143
2013	5798	4416
2014	7370	5613
2035	19695	15000

Source: TWDB, Rail Road Commission, and authors calculation



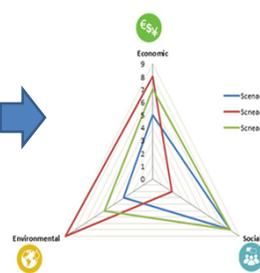
Sample Scenarios & Analysis

Scenario Inputs:

- Year evaluated
- Level of fracking activity
- Fracking fluid technology
- Onsite vs. Offsite water source
- Transport of produced gas/oil
- Produced water treatment
 - Onsite vs. Offsite
- Produced water disposal
 - Onsite vs. Offsite

Trade-off Analysis

Sustainability Index



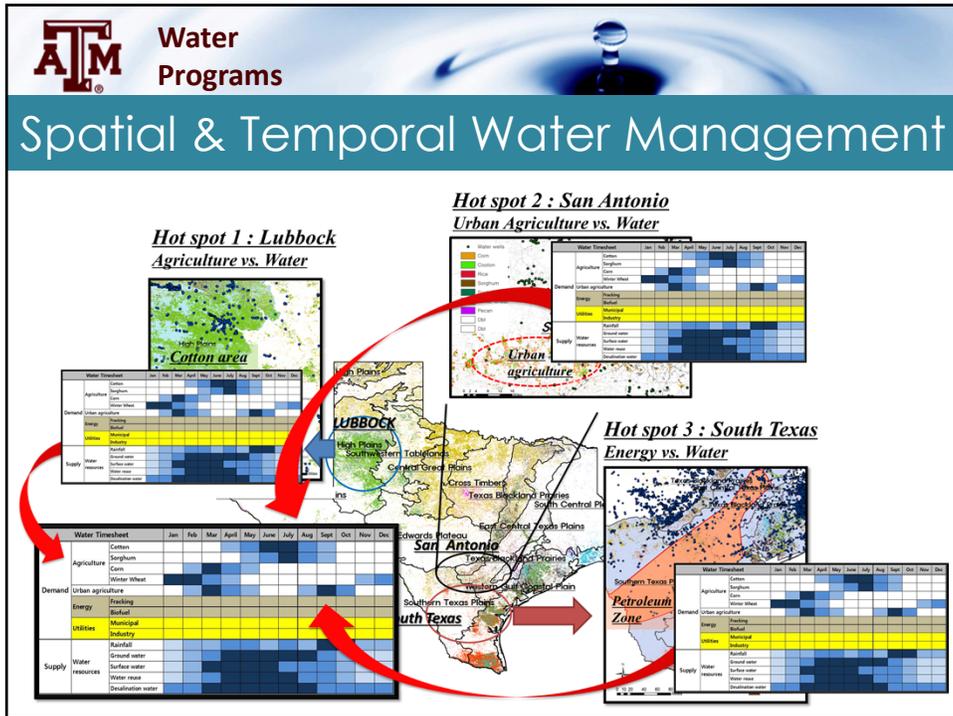
Scenario 1
36% increase in fracking

Scenario 2
50% increase in fracking

Scenario 3
10% increase in fracking

Scenario 4
S1 w/ Reuse all Water

Scenario 5
S1 w/ Water Source 50%on/50%off



Water Programs

Concluding Remarks

- Bridging the water gap requires **multi-stakeholders** approaches
- No silver bullets solutions. Water levers are:
 - **local**
 - **spatially** biased
 - **temporally** biased, yet **Holistic**

WEF Nexus Tool 2.0
The Resource Management Strategy Guiding Tool

**WATER AND ENERGY WORKSHOP:
UNDERSTANDING IMPACTS AND TRADE-OFFS
TO FACILITATE TRANSITIONS**

James A. Baker III Hall, Rice University

May 2015

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REGISTER NOW



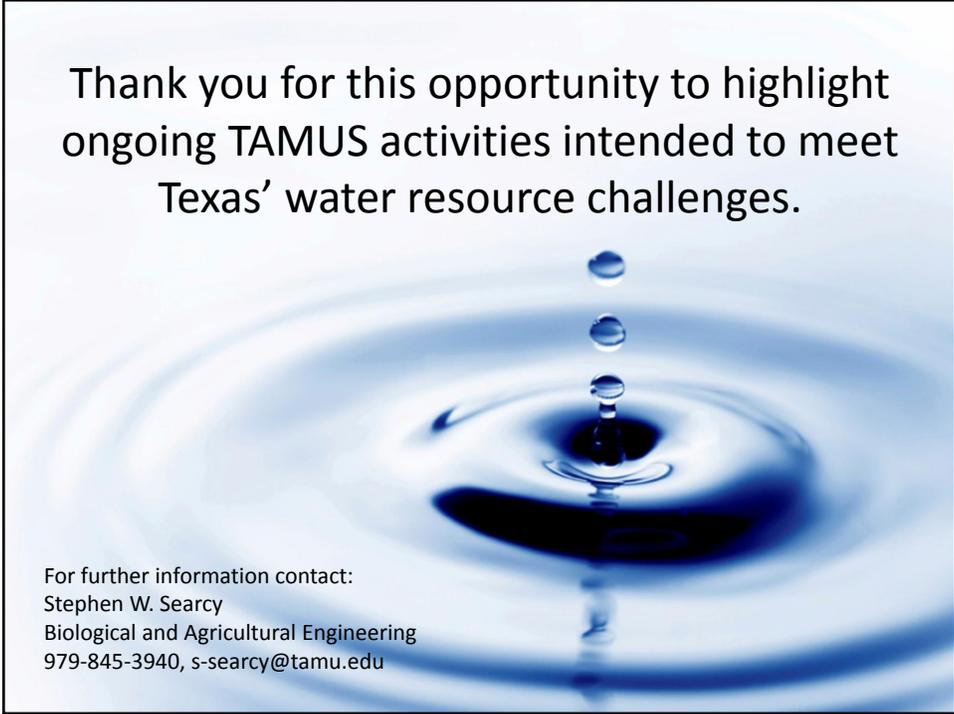
Water
Programs



Additional Water Programs

- Texas Water Resources Institute and its projects are well known to TWDB
- TAMUS faculty were offered the opportunity to share information about their activities with TWDB. Their slides are attached as a resource.
- AgriLife Research and Extension Service have numerous programs focused on water conservation and water use efficiency

Thank you for this opportunity to highlight ongoing TAMUS activities intended to meet Texas' water resource challenges.

A large, high-resolution photograph of a water droplet falling into a pool of water, creating concentric ripples. The background is a soft, light blue gradient.

For further information contact:
Stephen W. Searcy
Biological and Agricultural Engineering
979-845-3940, s-searcy@tamu.edu



ATM Water Programs

Texas Water Resources Institute

Designated Water Resource Research Institute for Texas in 1964

- **Priority areas:**
 - **Restore** water quality
 - **Conserve** water supplies
 - **Educate** professionals, students, and public
- **Conservation activities:**
 - Ag water conservation
 - Ogallala Aquifer Program
 - Lower Rio Grande Valley RCPP
 - Urban water conservation
 - Advanced Metering
 - Statewide outreach
 - txH2O, *Conservation Matters*
 - Engagement
 - Water Cons. Advisory Council
 - Brazos G RWPG
 - Brazos BBASC
 - Texas GW Protection Committee





Water Programs





**MOORE LAB
ECOHYDROLOGY**

Dr. Georgianne Moore

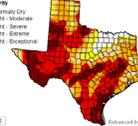
Associate Professor of Ecohydrology
<http://agriflife.org/gmoore/research/>



**ECOSYSTEM SCIENCE
AND MANAGEMENT**
TEXAS A&M UNIVERSITY

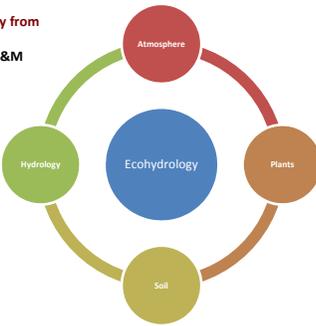
Characterization of Tree Mortality from the 2011 Texas Drought
 Funded by NASA and the Texas A&M Forest Service
 Project location: Statewide

Drought Monitor Archives



Released by FWSM

Nothing	00-04	01-04	02-04	03-04	04
4.93	95.07	90.05	77.46	54.96	29.12



Hydrologic and Plant Community Response to Extreme Drought and Wildfires
 Funded by Texas Parks and Wildlife
 Project locations: Bastrop and College Station




Hydrologic Response to Woody Plant Encroachment and Invasive Species
 Funded by USDA, DOE
 Project locations: Rio Grande, Pecos, Central Texas



Improving Land-Surface Modeling of Evapotranspiration Processes in Tropical Forests
 Funded by DOE Climate Science Program
 Project location: Costa Rica





Water Programs



Dr. Clyde Munster, P.E.

Professor / BAEN Dept.
Texas A&M University



- Expertise
 - Drought modeling / climate variability
 - Decision making tool for farmers / ranchers
 - Hydrologic modeling
 - Watershed scale simulations for water quality
 - Non-point source water quality
 - Land application of agricultural wastes
 - Onsite Sewage Facilities (OSSFs)



Water Programs

Hydrology & Water Resources Management
Zhuping 'Ping' Sheng, Ph.D., P.E., P.H., Professor
Texas A&M AgriLife Research Center at El Paso
zsheng@ag.tamu.edu

- Irrigation efficiency and ET monitoring
- Water resources database and decision support system
- Surface water model for Rio Grande flood control, ESA & water operations planning
- Groundwater Models:
 - Transboundary Aquifer Assessment
 - Far West Texas Regional Water Planning
 - High Plains Hydro-Econometric Assessment



Water Programs

Water Conservation in Urban Landscape & Agriculture
Genhua Niu, Ph.D., Assoc. Professor
Texas A&M AgriLife Research Center at El Paso
gnu@ag.tamu.edu

- Identification of salt and drought tolerant plants (ornamentals, vegetables, crops, fruit trees, etc.)
- Alleviation of stressful environments through sustainable practices (soil amendments, irrigation management, Mycorrhiza fungus, etc.)
- Use of alternative waters (reclaimed water, brackish groundwater, etc.) to irrigate crops and landscapes
- Plant production under controlled environments



Water Programs



Water, Salinity and Conservation Management

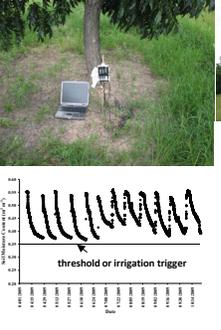
Girisha Ganjunte, Ph.D., Associate Professor
 TX A&M AgriLife Research Center at El Paso
gkganjunte@ag.tamu.edu



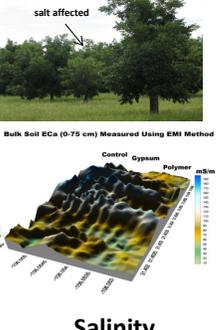
Reuse of Industrial Wastewater



Reducing Wastewater Salinity by Ammonium removal



On-farm Conservation using Sensors



Salinity Assessment and Management at Field Scale



Water Programs



Water Resources Economics and Policy Analysis

Ari M. Michelsen, Ph.D., Professor and Center Director
 Texas A&M AgriLife Research Center at El Paso
amichelsen@ag.tamu.edu

- Water resources quantity & quality valuation
- Economic impacts of alternative strategies & policy responses to prolonged and severe drought
- Agricultural & urban conservation program effectiveness
- Integrated Water Resources Management hydro-economic models & decision support systems
- Water use and value in energy production



ATM Water Programs

Water Conservation Projects at Amarillo AgriLife Research and Extension Center

- Irrigation Water Management – T. Marek
- Regional Water Planning – T. Marek, S Amosson
- ET Network and Calculator – T. Marek, D. Porter
- Open-lot Dairy Water Use – K. Casey



ATM Water Programs

Water Conservation Projects at Vernon AgriLife Research and Extension Center

- Tillage and Water Conservation – P. DeLaune, S. Park
- Hydrology, Watershed Management and Water Quality – S. Ale

 **Water Programs**



Tools for irrigation Management: Weather Station Networks, Soil Water Sensor Monitoring

Juan M. Enciso, Texas A&M AgriLife Research and Extension Center – Weslaco

 **Water Programs**



Bruce A. McCarl, distinguished professor, Dept. of Ag. Econ.,
mccarl@tamu.edu, <http://agecon2.tamu.edu/people/faculty/mccarl-bruce>

Expertise: applying regional/national models to study economic, agricultural, urban and environmental Implications of water transfers, water available, El Nino, climate change and strategy

Products:
articles, IPCC assessment reports, National Academies report, USGCRP assessment, EPA reports



Ron Griffin, water resource economist, Dept. of Ag. Econ.,
ron-griffin@tamu.edu, <http://ron-griffin.tamu.edu>

Expertise: urban pricing, water marketing, water policy, demand analysis, valuation, cost-benefit analysis

Example products:

Griffin, Ronald C. 2016 (in press). *Water Resource Economics: The Analysis of Scarcity, Policies, and Projects*. 2nd ed. Cambridge, MA: MIT Press.

Griffin, Ron and Sheila Olmstead. 2014. "SWIFT Water Plan Must Make Us Pay." *Austin American-Statesman*, p. A8, April 2.

Griffin, Ronald C. 2012. "The Origins and Ideals of Water Resource Economics in the U.S." *Annual Review of Resource Economics* 4: 353-77.

Griffin, Ronald C., editor. 2011. *Water Policy in Texas: Responding to the Rise of Scarcity*. Washington, D.C.: Resources for the Future.



James Mjelde, natural resource economist, Dept. of Ag. Econ.,
j-mjelde@tamu.edu

Expertise: dynamic analysis of natural resource issues, energy economics

Example products:

Olsen, K., J.W. Mjelde, and D.A. Bessler. 2014. "Integration among the Canadian and United States Natural Gas Markets." *Annals of Regional Science* 54: 117-142. (DOI) 10.1007/s00168-014-0648-7.

Amatya, R., J. Wight, J.W. Mjelde, and F. Hons. 2014. "Sustainable Bioenergy Sorghum [Sorghum bicolor (L). Munch.] Production for Biofuel and its Net-Returns." *BioEnergy Research* 7(4): 1144-1154. 2014. Digital Object Identifier (DOI) 10.1007/s12155-014-9451-7

Griffin, R.C. and J.W. Mjelde. 2011. "Distributing Water's Bounty." *Ecological Economics* 72(15 December): 116-128.

Griffin, R.C. and J.W. Mjelde. 2000. "Valuing Water Supply Reliability." *American Journal Agricultural Economics* 82(May): 414-426.



Water Programs

Roger Norton, research professor, Dept. of Ag. Econ. and Director for Latin America and the Caribbean, Borlaug Institute for International Agriculture. Roger.norton@ag.tamu.edu

Expertise: water management policies in developing countries

Example products:

Norton, Roger D. 2004. "Water Management Policies in Agriculture," ch. 6 in: Roger D. Norton, ed., *Agricultural Development Policy: Concepts and Experiences*. London: John Wiley & Sons, Ltd.

Norton, Roger D. 2004. "National Economic Policies and Irrigation in Yemen," appendix in: Roger D. Norton, ed., *Agricultural Development Policy: Concepts and Experiences*. London: John Wiley & Sons, Ltd.

Norton, Roger D. 1974. "Appraisal of Irrigation Projects and Related Policies and Investments" (with L. M. Bassoco and J. S. Silos). *Water Resources Research*. **10**, December.

Norton, Roger D., lead author. 2006. "Improved Management and Conservation of Biodiversity and Critical Watersheds in Panama." Report for USAID/Panama, May.



Water Programs

Luis A. Ribera, international trade and transportation economist, Dept. of Ag. Econ., Iribera@tamu.edu

Expertise: international trade, bioenergy, production economics and transportation

Example products:

Enciso, J., John Jifon, Juan Anciso, and Luis A. Ribera. "Irrigation Water Productivity of Subsurface Drip Irrigation versus Furrow Irrigation Systems Using an Internet Based Irrigation Scheduling Program." *International Journal of Agronomy*. Volume 2015 (2015), Article ID 178180, 6 pages.

Ribera, Luis A., and Dean McCorkle. "Economic Impact Estimate of Irrigation Water Shortages on the Lower Rio Grande Valley Agriculture." Texas A&M AgriLife Extension Service. June 2013.

Rodriguez, Hector G., Jennie S. Popp, Luis A. Ribera, Indrajeet Chaubey, and Brian Shaffer. "Implementation of Best Management Practices Under Cost Risk to Control Phosphorus Pollution in a Crop Based Watershed in Arkansas." *Journal of Environmental Monitoring and Restoration*. 3 (2007):195-207.



Ed Rister, The M. Edward Rister '74 Chair in Rural Entrepreneurship, Dept. of Ag. Econ., e-rister@tamu.edu

Expertise: economics of: BMPs for mitigating water quality issues, BMPS for irrigation districts, and potable water sources/treatment methods

Example products:

Lee, T., M.E. Rister, B. Narashimhan, R. Srinivasan, D. Andrews and M.R. Ernst. 2010. "Evaluation and Spatially Distributed Analyses of Proposed Cost-Effective BMPs for Reducing Phosphorous Level in Cedar Creek Reservoir, Texas." *Transactions of ASABE* 53 (5): 1619-27.

Rister, M.E., R.D. Lacewell, and A.W. Sturdivant. 2007. "Economic and Financial Costs of Saving Water and Energy: Preliminary Analysis for Hidalgo County Irrigation District No. 2 (San Juan) – Replacement of Pipeline Units I-7A, I-18, and I-22." Texas Water Resources Institute. TR-303.

Rister, M.E., C.S. Rogers, R.D. Lacewell, J.R.C. Robinson, J.R. Ellis, and A.W. Sturdivant. 2009. "Economic and Financial Methodology for South Texas Irrigation Projects - RGIDECON©." Texas Water Resources Institute TR-203 (Revised).

Sturdivant, A.W., C.S. Rogers, M.E. Rister, R.D. Lacewell, J.W. Norris, J. Leal, J.A. Garza, and J. Adams. 2007. "Economic Costs of Desalination in South Texas: A Case Study." *Journal of Contemporary Water Research and Education* 137 : 21-39.



Ron Lacewell, water resource economist, Dept. of Ag. Econ., r-lacewell@tamu.edu

Expertise: water planning (Texas Water Plan for region E and M), water in hydraulic fracturing, biological control of Arundo, benefit/cost of flood control, water conservation strategies for irrigation districts and on farm, policy

Example products:

Economics in Water Planning (Presentation for Water Summit in Austin (5/19/2014-co with Ari Michelsen)

UCOWR Panel (Texas v. New Mexico Supreme Court Water Case: Process, Issues and Interpretation)

Adusumilli, Naveen, Taesoo Lee, M. Edward Rister, and Ronald D. Lacewell. 2014. "The Economics of Mitigation of Water Pollution Externalities from Biomass Production for Energy." *Resources* 3: 721-733; doi: 10.3390/resources 3040721

Black & Veatch. 2015. Contract, Region M, water conservation strategies for agriculture.

Allen, Thomas. 2014. "Water Value and Environmental Implications of Hydraulic Fracturing: Eagle-Ford Shale." Outstanding Texas A&M University Undergraduate Thesis for 2014.





Water Programs

Lucy Camacho
 Environmental Engineering Department
 Texas A&M University - Kingsville

Desalination, Water Treatment and Concentrate Management
 Electrodialysis/Electrodialysis Metathesis Technology
 Zero-discharge desalination and minerals recovery

Research focus areas

- Desalination of brackish, and salty water.
- Separation of trouble chemicals.
- Recovery of minerals with marketing value.
- Hybrid RO/ED, RO/ED/EDM systems for ZDD.

Laboratory Equipment

- Semi-pilot, portable-compact MD unit.
- Capacity: 0.5-1.0 GPM.
- ED/EDM stack, ion-exchange membranes.







Water Programs

Dr. Jaehak Jeong (jeongj@tamu.edu)
 Blackland Research & Extension Center, BAEN

Research Interests: Water availability and water quality assessment for water and food security and environmental sustainability under rapid urbanization and climate change– (SWAT and APEX model development and assessment)

Assessment of Water Resources Conservation using Hydrologic Simulation models

- **Urban Stormwater Management - Modeling** (Sponsored by City of Austin)
- **Effects of Urbanization and Climate Change in Urban Stream Health** (Sponsored by EPA R6)
- **Small-Scale Irrigation Technology for Farmers** in Water Scarce African Countries (Sponsored by USAID)
- **Water Availability Assessment** for Maui Island using integrated SWAT and MODFLOW (USDA)

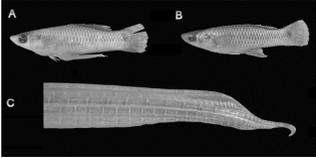
Environmental Sustainability of Agricultural Practices in Croplands

- **National Assessment of the USDA Conservation Program for Improving Water Quality** (USDA-NRCS)
- **Feasibility of Bioenergy Crop Production** in Hawaii: Water Availability and Environmental Sustainability Assessment (US Navy and USDA)
- **Best Management Practices for Agricultural NPS** in Korea (RDA, Korea)
- **Watershed Protection Plan** for Bacteria TMDL in Arroyo Colorado (TCEQ)



Thomas J. DeWitt
Ecology & Toxicology of Aquatic Organisms
tdewitt@tamu.edu





- Aquatic Predation Ecology (fish, mollusks, tadpoles)
- Adaptation of aquatic organisms to environmental variation (fish, mollusks)
- Aquatic toxicology (isopods, crayfish, marine and freshwater fish)
 - toxin assays
 - developmental instability of aquatic life is the best measure of environmental health
 - genetic instability
- New species descriptions
- Invasive aquatic plant determination
- Multivariate analysis

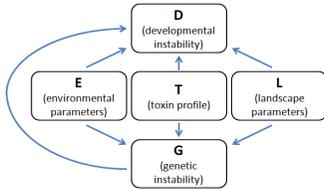
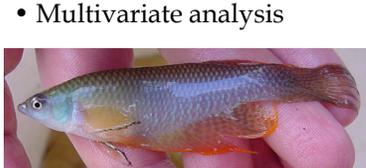


Fig. 1. Expected multivariate data block inter-relations.






Masami Fujiwara

Coastal Marine Fisheries

- Research Interest
 - Use of modern statistical analyses and mathematical modelling to understand population dynamics of penaeid shrimp and other species of economic and/or conservation interest
- Current Research Topics
 - Evaluation of the effects of river discharge on juvenile penaeid shrimp production
 - Investigation of the effects of coastal marsh conditions on juvenile penaeid shrimp survival and growth
 - Analyzing predator-prey interactions between juvenile penaeid shrimp and economically important fish species
 - Bioeconomics of coastal marine fisheries



ATM Water Programs

Delbert M. Gatlin III

Aquaculture and Fish Nutrition

- Research topics with prominent species such as channel catfish, hybrid striped bass, red drum, penaeid shrimp and tilapia include:
- Determining nutrient requirements and metabolism
- Developing and evaluating novel feed ingredients
- Evaluating dietary effects on immune responses and disease resistance



ATM Water Programs

Frances Gelwick

Fisheries Management Research

- Research topics in fisheries management:
- Hydrological and seasonal influences on stream fish assemblages, including macroinvertebrate prey resources and parasite infestations
- Comparative reproductive behaviors of wild and hatchery populations of native Guadalupe Bass (Texas State Fish) relevant to supplementary stocking efforts by TPWD to reduce effects of hybridization with non-native Smallmouth Bass
- Evaluating the role of newly established native vegetation in reservoirs including food web dynamics, growth and body condition of prey- and sport-fishes, and assemblage composition of their invertebrate prey and phytoplankton species.

 **Water Programs**



Research in the Roelke Aquatic Ecology Lab

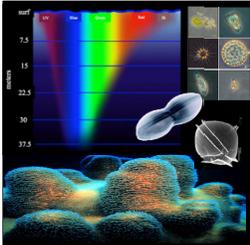
In Texas

- Harmful algal blooms, inland and coastal – ecology and mitigation
- River inflows to lakes and bays – ecosystem health



International

- Red Sea (Saudi Arabia) - Impacts of aquaculture and desalination on ecosystem structure and function
- Aegean Sea (Greece) – ocean circulation, nutrient loading and ecosystem functioning
- Inland lakes (Israel and Singapore) – alternative stable states and implications for management



Extension & Outreach Activities





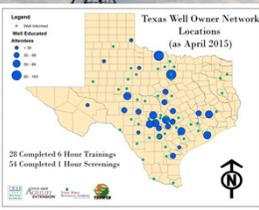

TEXAS WELL OWNER NETWORK

PROTECTING GROUNDWATER RESOURCES & HUMAN HEALTH

Impacts

6 month follow-up survey:

- 71% of participants with wells near contamination sources (pet shelters, livestock yards, etc.) had moved the sources.
- 89% of those needing to clean out hazards from their well house had done so.
- 55% of participants with septic tanks that needed pumping had pumped their septic tanks at no public expense.
- 38% of participants who needed to had plugged or capped their unused/deteriorated wells at no public expense.
- 74% shared the resources/materials with others who were not at the training.

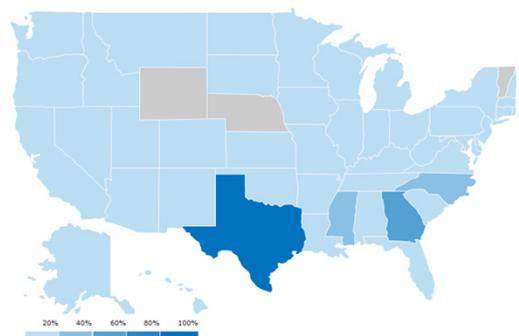






40 GALLON CHALLENGE

WATER CONSERVATION PLEDGE: **40gallonchallenge**.

Take the pledge to conserve water. Choose your state: **org**





Impacts:

- 60% increase in residential water availability
- 3600 Texas pledges to date
- 240 million gallons saved annually to date
- 6-month follow-up indicated 84% of participants followed through on 75-100% of their pledge



Water Programs

EARTH-KIND® ENVIRONMENTAL LANDSCAPE MANAGEMENT

- The Texas A&M Department of Horticultural Sciences' Earth-Kind Program yields highly significant water savings, while also protecting air and water quality by greatly reducing the need for fertilizers and pesticides on landscape plants.
- Based on years of research in several states, Earth-Kind Roses provide a:
 - **70% reduction in irrigation**
 - **Total elimination of fertilizers**
 - **Total elimination of pesticides on the plants**
- Earth-Kind Roses have become, to our knowledge, the fastest growing and most popular university program of its kind in the nation.



Water Programs



Dana Osborne Porter, Ph.D., P.E.
*Associate Professor and Extension Agricultural Engineering Specialist,
 Texas A&M AgriLife Research and Extension Center – Lubbock
 Research Program Leader and Associate Department Head,
 Department of Biological and Agricultural Engineering*



Integrated Applied Research and Technology Transfer to Promote Efficient Irrigation and Water Management in Agriculture

Objectives:

- develop, evaluate and promote appropriate application of advanced agricultural irrigation technologies, irrigation management tools and best management practices;
- improve quality and value of agricultural research programs through technical support to improve understanding of irrigation technologies, BMPs and related crop water management concepts; and
- provide relevant educational resources and opportunities for traditional and emerging audiences through irrigation workshops; agricultural conferences; individual contacts and mentoring; and print, electronic and mass media delivery.

Stakeholders: agricultural producers; landowners; crop consultants; agribusiness and associated professionals; agricultural and natural resources agency professionals; irrigation, environmental and engineering professionals; extension and research professionals.



ATM Water Programs



Texas Watershed Steward Program

- **Course Description:** No-cost, half-day introductory training in the fundamentals of watersheds and watershed management with the purpose of increasing citizen awareness and involvement in the stewardship of Texas' water resources.
- **Target Audience:** Individuals representing all stakeholder groups: [Agriculture](#); [urban](#); [business/industry](#); [city/county officials and personnel](#); [landowners](#); and [homeowners](#)
- **Extras:** Earn continuing education credits at no cost (ex: P.E., Certified Crop Advisor, Certified Planner, etc.), and receive free course materials including multiple water-related publications.


<http://tws.tamu.edu/>


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ATM Water Programs



Watershed Protection Planning

- Stakeholder driven, non-regulatory approach for addressing surface water quality issues in Texas. Got it.
- Utilized to protect healthy waters and restore impaired waters.
- Facilitates the implementation of Best Management Practices by providing technical and financial assistance to stakeholders.







Water Programs



Rainwater Harvesting

- County Extension Agents
- Master Gardener Specialist
- Professionals
 - Certification
 - CEUs
- Homeowners
- Livestock
- Wildlife
- Potable
- Firefighting



Kaufman County Demonstration



Water Programs



Steve Amosson, extension management economist-Amarillo,
samosson@ag.tamu.edu

Expertise: water policy, demand analysis, valuation, cost-benefit analysis

Example products:

Amosson, S. H., B. Guerrero, and H. Graham. 2014. "The Economic Impact and Water Use of the Small Grains Industry in the Southern Ogallala Region." September. AG-012, Texas A&M AgriLife Extension Service.

Amosson, S. H., B. Guerrero, and H. Graham. 2014. "The Economic Impact and Water Use of the Feed Grains Industry in the Southern Ogallala Region." 2014. AG-011, Texas A&M AgriLife Extension Service.

Amosson, S. H., S. Nair, T. Marek, D. Jones, J. Yates, B. Guerrero, and M. Jones. 2014. "2015 High Plains Irrigated Crop Profitability Analyzer." December. Texas A&M AgriLife Extension Service.

Amosson, S., L. Almas, J. Girase, N. Kinney, B. Guerrero, K. Vimlesh and T. Marek. 2011. "Economics of Irrigation Systems." October. B-6113, Texas AgriLife Extension Service.



David P. Anderson, livestock and food products marketing,
Dept. of Ag. Econ., danderson@tamu.edu

Expertise: livestock and dairy economics, ag. policy, economic impact of drought

Example products:

Anderson, D.P., J.M. Welch, and J.R.C. Robinson. "Agricultural Impacts of Texas's Driest Year on Record." *Choices*. Third Quarter, 2012.

Anderson, D.P. "Cattle and Calf Prices Recover a Little After the Shock of Drought." *Ag. Monthly*, October, 2012.

Falconer, L. and D.P. Anderson. "The Impact of the 2011 Drought on the Cattle Industry in South Texas and Outlook for Recovery." Texas AgriLife Extension Service. April 19, 2012.

Anderson, D.P., J. Robinson, J.M. Welch. "2011 Crop and Livestock Drought Losses Top \$7.6 Billion; Commercial Timber Losses add Another \$669 Million." March 22, 2012.



Tiffany Dowell Lashmet, assistant professor & extension specialist – agricultural law, Dept. of Ag. Econ.
tdowell@tamu.edu

Expertise: legal issues impacting landowners including Texas water law.

Example products:

Dowell, Tiffany, 2014. *You Can Lead Livestock to Water...A Survey of Exempt Livestock Wells in the West*, 17 U. Denv. Water L. Rev. 1.

Richardson, Jesse and Tiffany Dowell, 2012. *The Implication of Bounds v. State of New Mexico*, J. of Contemporary Water Research and Educ.

Dowell, Tiffany, 2013. *Texas Water: Basics of Groundwater Law*, Texas Agriculture Law Blog, <http://agrilife.org/texasaglaw/2013/10/22/texas-water-basics-of-groundwater-law/>.

Dowell, Tiffany, 2013. *Texas Water Wars: Texas v. New Mexico*, Texas Agriculture Law Blog, <http://agrilife.org/texasaglaw/2013/09/18/texas-water-wars-texas-v-new-mexico/>.



Water Programs

Rob Hogan, district economist and management specialist, Dept. of Ag. Econ., Rhogan@ag.tamu.edu, <http://agecoext.tamu.edu/>

Expertise: water policy, drought mitigation, demand analysis

Example product:

Borisova, Tatiana, Steve Amosson, Tracy Boyer, Rob Hogan, Bridget Guerrero, John Michael Riley, Jeff Mullen, Larry D. Sanders, Amanda Smith, Nathan Smith, Bradley Watkins, John Westra, David Willis. 2015. The Future of Water Resources in the South: Challenges and Potential Solutions. Invited Symposium at the annual meeting of Southern Agricultural Economics Association. Atlanta, GA.



Water Programs

Jason Johnson, extension economist, Dept. of Ag. Econ., jljohnson@tamu.edu; (254) 968-4144

Expertise: cost-benefit analysis, assessment of best management practices, agricultural water demand analysis

Example products:

Johnson, Jason L. 2014. *A Benefit-Cost Analysis of Texas Weather Modification Activities Resulting in an Additional One Inch of Rainfall Across a Region*. Report submitted to West Texas Weather Modification Association, et al..

Lambert, Barry, Kelly Hibbeler, DeeAndra L. Lambert, Jason L. Johnson, Larry Beran, and James Marsh. 2013. *Recovery Potential Screening Tool Analysis for Specified Segments in the Trinity River Basin*. Texas A&M AgriLife Research Report submitted to Texas Commission on Environmental Quality, Contract No. 582-9-90439.

Johnson, Jason L., Clint Wolfe, and David Waidler. 2012. *An Economic Assessment of Water Quality Improvement BMPs for the Eagle Mountain Lake Watershed*. 2012 Agricultural and Applied Economics Association Meetings, August 12-14, 2012, Seattle, Washington.

Taesoo Lee, Jason L. Johnson, Raghavan Srinivasan. 2011. *Cost Effective Multiple BMPs to Reduce the Total Phosphorous Level in a Reservoir*. 2011 International Soil and Water Assessment Tool Conference, University of Castilla La Mancha, June 15 - 17, Toledo, Spain.



Richard Woodward, professor, Dept. of Ag. Econ.,
r-woodward@tamu.edu

Expertise: water quality policy

Example products:

Newburn, David and Richard T. Woodward. 2012. "An Ex Post Evaluation of the Great Miami Water Quality Trading Program." *Journal of the American Water Resources Association*. 48(1): 156–169.

Woodward, Richard T. 2011 "Double Dipping in Environmental Markets" *Journal of Environmental Economics and Management*. 61(2):153-169

Woodward, Richard T. and W. Douglass Shaw. 2008. "Allocating Resources in an Uncertain World: Water Management and Endangered Species" *American Journal of Agricultural Economics* . 90(3):593-605.

Woodward, Richard T., Ronald A. Kaiser and Aaron-Marie Wicks. 2002. "The Structure and Practice of Water-Quality Trading Markets." *Journal of the American Water Resources Association*. 38:967-979



Si-Wi: Sustainable and Integrated Water Infrastructure

- Education, Demonstration, and Training Programs to encourage:
 - Reuse/Multiuse,
 - Decentralization, and
 - Desalination
 for bridging the gap between projected water demand and existing water supply in Texas (The Water Gap).
- SWIPES – Sustainable Water Infrastructure Planning and Evaluation System, a computer system proposed as one of the tools to promote **Si-Wi**.

Dr. Anish Jantrania • Texas A&M AgriLife Research & Extension • Blackland Research & Extension Center
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Water
Programs



Aquaculture & Fisheries Extension- Todd Sink

- Aquaculture production practices and methods
- Farm pond management
- Aquatic vegetation management
- Aquaponics food production
- Water chemistry analysis and amendments for fish