

### **Southeastern Food and Agriculture Indicators. Status and Indicators**

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#### **The Soil Resource**

“Agriculture was the South, economically and in environmental impact...” states environmental historian, A.E. Cowdry (1996). For two to three centuries, the South has been one of the world's major agricultural and silvicultural regions. The large crop and forest productivity is supported by mild humid climates, generally level landscapes, and soils that are often physically amenable to management. While there is exceptional soil diversity across the region, advanced weathering-stage soils cover much of the region, soils with relatively low native fertility and few if any primary minerals able to buffer nutrient uptake and removal in harvests.

The several centuries of use have substantially transformed the region's soils physically, chemically, and biologically. Millions of hectares, especially in the Piedmont, have been severely eroded and largely abandoned of agriculture. Today the eroded old-field Piedmont supports secondary pine and pine-hardwood forests, hayfields and pastures and is an internationally recognized example of non-sustainable agricultural management (Trimble 1974).

Soils in the other regions of the South, the Coastal Plains, Blackbelt Prairie, Appalachian Mountains, and the many river bottoms, may not have been as physically impacted by past land use as the Piedmont, but nonetheless have been substantially altered by past use. Future soil management for sustainable crop and animal production, and wood harvests for solid wood products, pulp, and energy, all require a soil management that is much more sophisticated than that implemented in the past. Today and in the future, soil management sustainability not only includes long-term sustenance of harvests but also the reduction of adverse on-site and off-site effects of management. Given that the region is so extensively covered by advanced weathering soils, sustainability depends much more on the care managers practice of the land than it might in other regions where soil resources might be able to better buffer impacts of management.

Soils sustainability needs also to be evaluated in the context of sprawling urban, suburban, and industrial development. Sustainability of soil use for food and fiber production is vulnerable from development sprawl, impacts very undifferent from those discussed previously. New homes, urban areas, and industrial developments are proliferating across the South transforming the rural character of many landscapes. Several states are losing on the order of a million acres of rural land per decade to development (Schaberg et al. 2003). While this is an issue challenging the future of rural areas throughout the world, the South seems particularly vulnerable to such conversions given the region's currently rapid growth and its historical tendency not to regulate land-use decisions.

Strong forces are combining to create tension between renewable sources of energy with fossil sources across the region. Although highly visible are potential uses of soils for biofuels products, the “heavyweight” of renewables is most likely wood. Given that over the last 50 years, the region has harvested more industrial wood products than any other region in the world, as industrial harvests of wood especially for pulp and paper diminish, the opportunity for energy wood production would seem to increase. The scale at which wood energy development plays out, whether as a decentralized, community-based system of many small advance wood combustion facilities (<10MW each) or as a system of centralized, monopolistic wood combustion plants (50 to >100 MW each), is yet to be determined but will have a major impact on the future soil resource and its management.

Invaluable contributions to future environmental management of the region's land would be a network of soil-ecosystem studies dispersed across the region's diverse land forms, geologies,

and land uses. This could be efficiently operated and serve over the decades, not only to improve land management but education about sustainability as well.

**Nitrogen:** Today we are an extractive society mining the energy needs deposited many eons ago through the slow metabolic processes of photosynthesis and if we are to become sustainable as a species we will have to develop alternatives to this extractive paradigm. Recently the pressure on all food stuffs have driven prices to such levels that food riots are commonplace in many developing countries and the debate in developed countries continues as to the efficacy of using starch and sugar laden foods as a feedstock for the ethanol industry. Underlying all of this is the *Nitrogen Limitation Factor*. The advent of cheap  $\text{NH}_3$  within the food system has propelled the anthropogenic disruption of the nitrogen cycle. This disruption increases GHGs, polluted aquifers supplying potable water, eutrophied estuaries and created “dead zones” throughout the world, and in general stressed the biosphere. There is activity addressing the management of this disruption with more efficient use and other mechanisms similar to those used to manage GHG emissions and this should become a priority as we address sustainability in our food system. Robert Socolow presented a paper to the National Academy of Science “*Nitrogen management and the future of food: Lessons from the management of energy and carbon*” in December of 1998 which addressed the science and remedies for this serious problem. Dr Socolow suggests the following; (i) set the goal of ecosystem stabilization; (ii) search the entire production and consumption system (grain, livestock, food distribution, and diet) for opportunities to improve efficiency; (iii) implement cap-and-trade systems for fixed nitrogen; (iv) expand research at the intersection of agriculture and ecology and (v) focus on the food choices of the prosperous. As Dr. Socolow focuses on the limitation of chemical nitrogen we must also turn our attention to those practices such as nitrogen fixation by legumes as cover crops and farms which are agroecological and rely on natural nutrient recycling processes.

**Water:** Water consumption in the South is increasing with population increases, especially in urban centers and along the coast. Water availability is generally decreasing, especially in rivers and reservoirs in high-demand urban centers and in some ground water aquifers in high-use coastal plain regions. During recent droughts, per capita water consumption decreased as municipalities implemented water use restrictions and price increases. When water supply restrictions are relaxed, water consumption tends to increase. In fact, because water treatment operating budgets are driven by revenues, municipalities often encourage water use during normal rainfall periods in order to maintain operating budgets.

Trends are well-documented over the past 20 years and can be predicted for the next 10 to 20 years based on past usage rates. The conflicts among water users over limited water supplies will continue to increase while new technologies and policies are put into place to improve water use efficiencies and promote water reuse. There is a great need to develop long-term economic and technological strategies for providing adequate water supplies to match efficient water use rates.

We must track water consumptive use and availability in each river basin in the South. Water use should be tracked for each major user group: agriculture, industry, municipalities, and environmental flows. Water availability should be tracked by monitoring ground water levels, river flow rates, and reservoir levels over time to determine how supplies change in relation to consumptive use and climate change. In addition, the quality of these water supplies should be monitored to determine treatment requirements. Appropriate scales are river basin, statewide, and regional. The United States Geological Survey is the most authoritative source of water availability data with some supplemental information available from states. Data quality should be improved by developing a standardized reporting system for all water users in each river basin and by increasing the density and frequency of the water supply monitoring network (for surface and ground water).

**Climate:** Ongoing climate change brings in some uncertainties for agriculture in the Southeast US. **Atmospheric elevated CO<sub>2</sub> concentration:** The atmospheric CO<sub>2</sub> concentration is projected to continue to increase through this century. The rising CO<sub>2</sub> is predicted to increase crop production because of higher CO<sub>2</sub> in general stimulates photosynthesis of crop plants, particularly C<sub>3</sub> species. However, the prediction of the “CO<sub>2</sub> fertilization effect” is largely based on experiments in open-top chambers and other controlled environments, which may have led significant overestimation (Long et al., 2006). Soils in the South particularly the Coastal Plains and the Piedmont are highly weathered, and their fertility is extremely low, raising question into whether the prediction of “CO<sub>2</sub> fertilization” can be materialized in field. Plant responses to elevated CO<sub>2</sub> in tropical or subtropical areas are poorly studied and more research is needed to understand the complex interactions among soil, plants and atmospheric composition.

**Elevated atmospheric ozone (O<sub>3</sub>):** Agricultural production in the Southern US could be particularly vulnerable to high atmospheric O<sub>3</sub> because some major crops in this region (e.g., soybean and peanut) are among the sensitive species to elevated O<sub>3</sub> (Van Dingenen et al., 2009). It has been shown that higher atmospheric CO<sub>2</sub> can partially offset the inhibitive effect of O<sub>3</sub> on plants, but the mechanisms and magnitude remains largely unclear (Fiscus et al., 2005). Also, screening or breeding of O<sub>3</sub> tolerance of crop cultivars is also needed.

**Temperature increase and variability:** The global surface temperature has been increasing over the last several decades and this trend will continue in the next several decades. Compared to the Midwest and other Northern regions, the average temperature increase in the South is predicted to be less drastic. However, it is the increasing temperature extremes that pose greatest threats to the agriculture in this region. A generally warm winter followed by severe chills in the early spring has been shown to be very devastating to many crops, particularly states in the transition zones like North Carolina. Also, the increasing temperature, combined with potential changes in rainfall patterns under future climatic conditions, may alter the long distance movement of plant pest insects and pathogens. Changes in the timing and pathways of airborne pathogens such as tobacco blue mould can pose major challenges for predicting disease epidemic and implementing management practices in a timely manner.

**Farm Trends:** There has been a systemic change in agriculture in the south since the early 1980's. Traditional crops supported many farms (in various systems of well being or labor exploitation like share cropping and rental arrangements) until the 1980's, but since then the overall trends in terms of numbers engaged in farming as farmers and rural economic health (jobs) have all been steady in terms of decline. Problems of systems and of multifunctionality, multiple-job holding strategies of farms (especially asset management in terms of land, and labor) in the South are blocked by a myth of “real farms” versus “hobby farms”. We tend to have poor yields for most commodities and do not compete with other regions of the country. Some of the mainstay crops had serious drawbacks, for example sugar (poor international competitor), tobacco (poor public image), cotton (largest chemical use), livestock systems (cow-calf outshipping to midwestern CAFOS, swine and poultry CAFOS). Sprawling cities are putting alternative development pressures in situations that are strong land-owner rights states. In much of the south, political power and resource allocation are still viewed through a racial lens.

The US Census provides a good source of trend data, and the 2007 data has just been released. Comparing 2007 census data to 1982 census data, the number of farms has gone up 31,850 while the land in farms has been reduced 13,249,698. This reflects the larger number of small farms, but reduction in overall acreage devoted to agriculture. North Carolina has lost 1000 farms since 2002, and total farm acreage has decreased approximately 500,000 acres. North Carolina is tied for first in the nation in farm loss. The number of farms that are below 9 acres has grown by 600 however. The average age of farmer is 57.

**Food Prices, Health, and Access to Food:** Overall, it is well recognized that food prices in the US are much lower than in most other parts of the world, but within that, the calorie dense and nutrient poor foods are much less expensive than healthier options. An ongoing challenge is to assure access by individuals of all income levels to sustainably produced, fresh, local and healthy food. Monitoring access of low income populations to these sources of food will be key to assuring equity when addressing the development of local sustainable food economies.

It is important to consider obesity and chronic disease prevention in addition to food insecurity. Unfortunately, high rates of food insecurity AND obesity/chronic disease are often correlated. At this point, obesity rates continue to rise, particularly among children and underserved populations. Food insecurity is likely to increase as the economy declines. As is so often the case, in our quest for economic growth related to sustainable food systems, it will be key to assess and monitor whether health disparities are exacerbated – both from the producer and consumer perspectives.

Very limited data currently exist linking food and health status with sustainable local food systems. Given the obesity epidemic and resulting adverse impact of chronic disease on our economy as well as our physiologic and mental well being, data linking SLF with obesity prevention could be critical to moving this field forward. We have the challenging task of changing social norms to support valuing high quality food produced sustainably as worthy of spending a greater portion of our income while improving access to the poor.

Data about these indicators is mixed with regards to availability and completeness. Data about food prices are probably most easily available through the food industry, though the datasets can be very costly. Some universities have purchased these datasets and may be able to provide access. USDA calculates a “Thrifty Food Plan” at the levels of Low-Cost, Moderate-Cost, and Liberal Food Plans each designed to represent a nutritious diet at a different cost. The low cost Thrifty Food Plan is the basis for food stamp allotments. From testing this plan, it is generally thought to require very resourceful food purchasing and preparation to be able to purchase adequate food on these plans. USDA also provides data on income and price elasticities to assist with interpretation of food prices in a given economic environment.

The most nationally available, frequently updated, and adaptable health data system is the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is the world’s largest, on-going telephone health survey system, tracking health conditions and risk behaviors in the United States yearly since 1984. The BRFSS is a state-based system of health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. For many states, the BRFSS is the only available source of timely, accurate data on health-related behaviors. BRFSS was established in 1984 by the Centers for Disease Control and Prevention (CDC); currently data are collected monthly in all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. More than 350,000 adults are interviewed each year, States use BRFSS data to identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs. Many states also use BRFSS data to support health-related legislative efforts. States and universities have the option to purchase additional questions to be included in their state level BRFSS administration, which can be used to collect more specific information related to health, nutrition, and local food systems.

There are many different instruments of varying length that have been used to Assess and monitor food insecurity. Such measures have been used by some states over selected years as part of the BRFSS data collection but the approach has not been systematic. Periodic large health-related surveys such as NHANES and the CSFII have included food security measures as well.

**References available upon request**