

Introduction

Use of biomass for bio-derived fuels, industrial chemicals, power, and other consumer products holds the promise of spurring new technologies, sectors, and job growth in both rural and urban areas. Growth of a bioeconomy would produce more environmentally friendly chemicals, reliance on renewable substances for manufacturing, and recovery of both non-renewable and renewable materials from biogenic wastes for higher-value purposes. The energy sector would see more diversity in fuel sources and, in many instances, reduction in life-cycle greenhouse gases in comparison to fossil-fuel derived products. Reliance on aquatic and terrestrial biomass and biogenic wastes will inevitably result in land use changes and reliance on natural resource systems. As potential for a bioeconomy grows, tools are needed to assess whether specific pathways (i.e., feedstock, production, and product use) will mitigate or exacerbate public health challenges and demand on already taxed ecosystem services. Regional sustainability assessments of proposed pathways can guide sustainable development of an emerging bioeconomy.



Linking Environmental, Health and Social Sciences for Sustainability Assessment

In 2011, the US Environmental Protection Agency was challenged by the NRC⁴ to develop a framework for sustainability assessments that would go beyond the risk assessment paradigm to include social, environmental, and economic factors, including not only pollutants and chemicals but also community, jobs, and quality of life.

In a subsequent report (2014), the NRC⁵ recommended specific criteria to evaluate various tools for sustainability assessments. We focus on the applicability of the EnviroAtlas⁶ (<http://www.epa.gov/enviroatlas>) as a tool that already meets criteria for documentation, maturity, software availability, and capability for screening level analyses.

The following attributes distinguish Sustainability Assessment from the many other types of environmental assessments:

- Systems-based analyses.*
- Addresses availability of natural resources for future generations; efficient utilization of energy; minimization of wastes and chemical pollution.*
- Takes a long-term perspective to anticipate and address potential adverse outcomes.*
- Acknowledges the dynamic and adaptive nature of integrated human and ecological systems through time and space.*
- Aims to increase resiliency of human and ecologic systems to perturbation, including catastrophic events.*
- Recognizes community health, economic vitality, and ecological balance as mutually reinforcing rather than mutually exclusive objectives.*



Challenges of a Federal Bioeconomy

The concept of a national bioeconomy is propelled by the promise of clean, affordable energy production accompanied by social, economic and environmental benefits such as rural economic development, increased carbon sequestration, net greenhouse gas reductions, and higher value use of biogenic wastes. The challenge of conducting a Sustainability Assessment for a federally coordinated bioeconomy is confounded not only by the option of many technology pathways for production of biofuels, biopower, biochemicals, and other bioproducts, but by uncertain benefits and potential adverse impacts to natural and human systems. We present some of the attributes of the EnviroAtlas⁶ tool for accessing data relevant to a Sustainability Assessment of the bioeconomy.



Maintaining Ecosystem Goods and Services is a Major Consideration for a National Bioeconomy

The EnviroAtlas includes an interactive map that organizes ecologic, demographic, and geophysical data according to seven benefit categories. Here we show the partially exploded menu of data layers available under just one topic, Water:

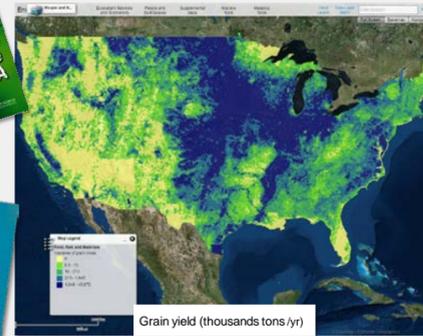
- Clean Air
- Clean and Plentiful Water
- Natural Hazard Mitigation
- Climatic Stabilization
- Recreation, Culture, and Aesthetics
- Food, Fuel, and Materials
- Biodiversity Conservation



The EnviroAtlas contains hundreds of data layers that can be viewed at two scales: national and community. The national component of EnviroAtlas summarizes data for the 48 mainland states by 12-digit hydrologic unit codes (HUC) of which there are about 90,000 in the United States. Each HUC covers about 40 square miles. Community data layers are summarized by census block group for twelve communities. By 2019, EnviroAtlas will feature data for more than 50 U.S. communities at a resolution of 1 m.

The best way to appreciate the magnitude of information is to visit the website (<http://www.epa.gov/enviroatlas>) and take the tour!

Landscape Features



EnviroAtlas: Assessments can be facilitated by ready access to national data on vegetated land cover, crop yields, synthetic fertilizer usage, impaired waters, and other relevant data. Importantly data access and visualization will promote collaboration across public and private sector: federal, state, and local government, tribes, business to mitigate potential negative impacts of increased land use.

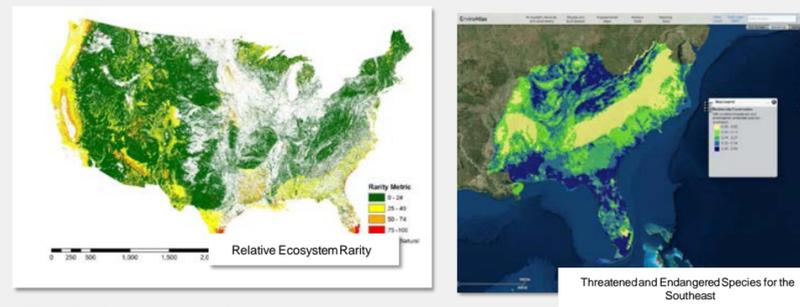
Optimizing Land Use: An expanded bioeconomy envisions a significant impact on America's landscape with opportunities to improve ecological services while mitigating negative impacts of increased land use.

Development of non-food crops capable of thriving on marginal lands, requiring less inputs for production, while reducing nutrient run-off and soil erosion is an example.

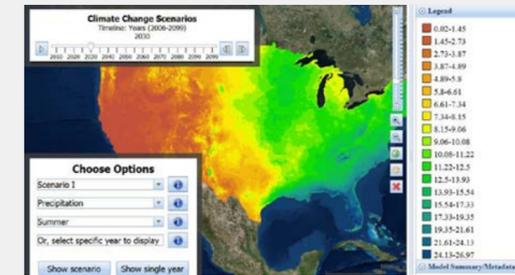


Synthetic Fertilizer Use

Vulnerable Landscapes and Species



The **EnviroAtlas** provides data on sensitive resources (observed species, habitat for vulnerable species, limited water supplies) as well as opportunities for development.

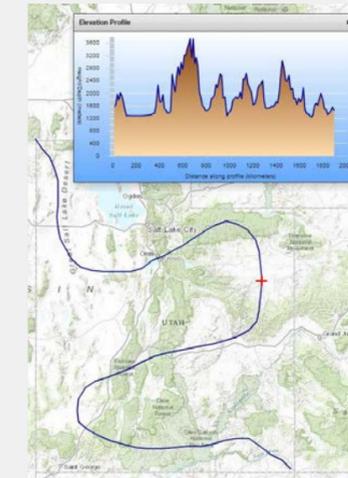
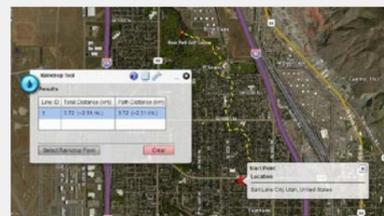


Future scenarios for land use and climate change can be used to explore possibilities of co-benefits or unintended consequences. This feature will be available soon.

Analytic Tools

The **Raindrop tool (below)** allows users to select a location on the map to locate the general raindrop flow path and distance to the nearest water feature using National Hydrography Dataset Plus V2 (NHDPLUSV2).

The **Elevation tool (to the right)** allows users to see the elevation gradient between two points.



Site Specific Demographic and Workforce Data



A flourishing bioeconomy would require development of a skilled workforce to fill new jobs in agriculture and forestry production, biorefineries, transportation, manufacturing, and allied fields.

The EnviroAtlas contains census data on socioeconomic status, age, education and ethnicity of local populations, which could inform accelerated development of labor pools. Employment opportunities in biobased technologies and commercial products would help diversify and stabilize rural economies.



Conclusions

National expansion of the bioeconomy has potential for significant economic, environmental, and social outcomes if major hurdles can be overcome. These include concerns over environmental issues associated with growing biomass as well as mitigating/reducing negative impacts of limited availability of land and resources (e.g., water, fertilizer, labor, etc.) to produce one billion tons of biomass.

We recommend a screening level Sustainability Assessment for a National Bioeconomy to evaluate potential exposures, vulnerable ecosystems services, and opportunities to mitigate impacts.

The EnviroAtlas is a rapidly maturing data and analytic resource with key features of well-documented data, ease of use, and capability for screening level assessment of relevant demographic and workforce considerations to support a sustainability assessment at these early stages in the planning for a bioeconomy.



Bibliography & Acknowledgments

- ³The National Bioeconomy Blueprint. 2012. Washington, D.C
 - ⁴Sustainability and the U.S. EPA. 2011. NAS Press, Washington, D.C. pp. 286.
 - ⁵Sustainability Concepts in Decision Making: Tools and Approaches for the U.S. EPA. 2014. NAS Press, Washington, D.C. pp. 155.
 - ⁶EnviroAtlas is a collaborative project developed by the US EPA in cooperation with the US Geological Survey, the US Department of Agriculture's Natural Resources Conservation Service and Forest Service, and LandscapeAmerica.
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