Promoting beneficial land-use change: guiding decisions toward positive outcomes

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Workshop: The world needs more land-use change

24th European Biomass Conference and Exhibit (EUBCE 2016)

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Virginia H. Dale, CBES team
http://www.ornl.gov/sci/ees/cbes/

Toward positive LUC outcomes: How to get there from here?

Outline

- Science-based information to guide decisions
  - Indicators
  - Causal analysis
  - Standards
- Process of monitoring, analysis & continual improvement
- Discussion & examples
  - ‘Natural climate mitigation’
  - Food, fuel and other services
  - Guatemala

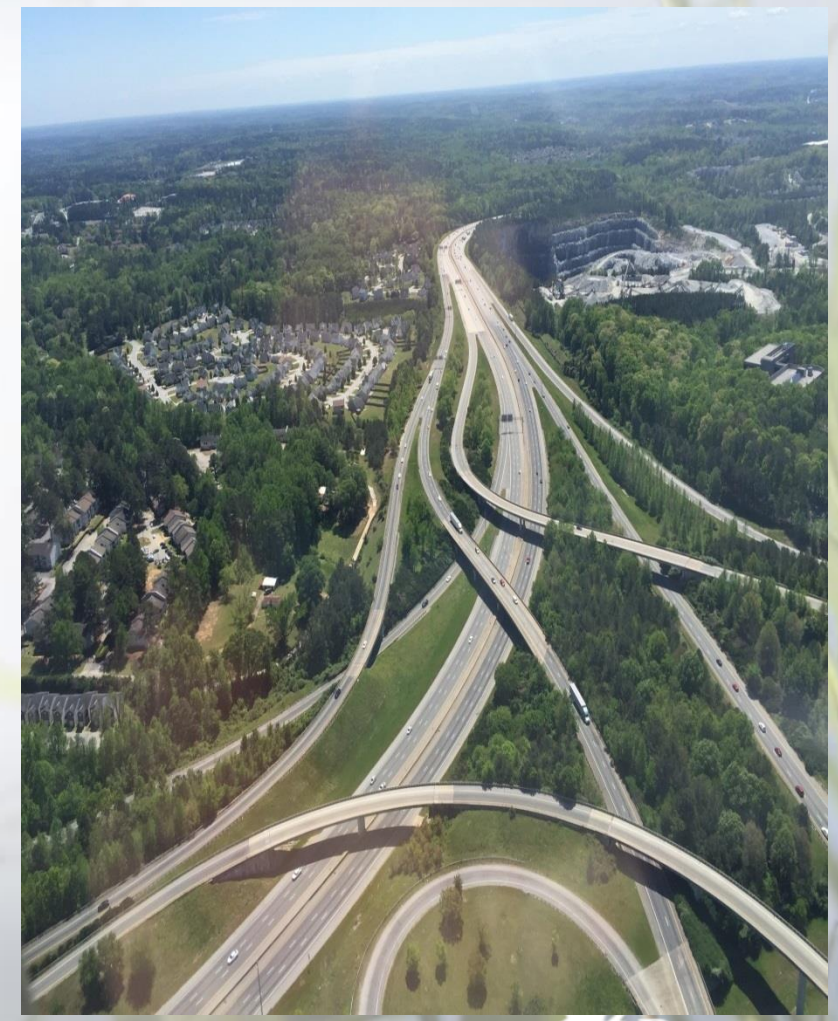


Photo by Kline: LUC near Atlanta, GA

Science-based analysis to guide decisions

Science: systematic methodology based on evidence and observation

- ✓ Start with clear definition of problem
- ✓ Ask right questions
- ✓ Test hypotheses
- ✓ Conduct critical analysis
- ✓ Determine cause and effect
- ✓ Document verifiable, replicable results
- ✓ Build on and learn from others (epidemiology)

- **Confounding data and terminology**
  - ✓ Land cover versus land uses (multiple) and management
  - ✓ Crop price and trade versus total production and actual uses, losses
  - ✓ Correlation versus causation
- **Science evolves as new data and understanding become available**
- **Targeted data collection**

Environmental indicators for bioenergy sustainability & associated ecosystem services

Category	Ecosystem service: type	Indicator
Soil quality	**Supporting and regulating service:** soil quality	Total organic carbon (TOC)
		Total nitrogen (N)
		Extractable phosphorus (P)
		Bulk density
Water quality and quantity	**Regulating service:** drinking water; **Cultural service:** recreation	Nitrate concentration in streams
		Total phosphorus (P) concentration in streams
		Suspended sediment concentration in streams
		Herbicide concentration in streams
		Peak storm flow
		Minimum base flow
		Consumptive water use (incorporates base flow)
Green-house gases	**Regulating services:** carbon sequestration and climate regulation	CO_2 equivalent emissions (CO_2 and N_2O)
Bio-diversity	**Regulating services:** biodiversity, pollination, seed dispersal, pest mitigation; **Supporting service:** habitat	Presence of taxa of special concern
		Habitat area of taxa of special concern
Air quality	**Supporting and regulating service:** air quality	Tropospheric ozone
		Carbon monoxide
		Total particulate matter <2.5μm diameter ($PM_{2.5}$)
		Total particulate matter <10μm diameter (PM_{10})
Produc-tivity	**Production services:** food, feed, fiber and fuel	Yield

McBride et al. (2013) & Dale et al. (in review)

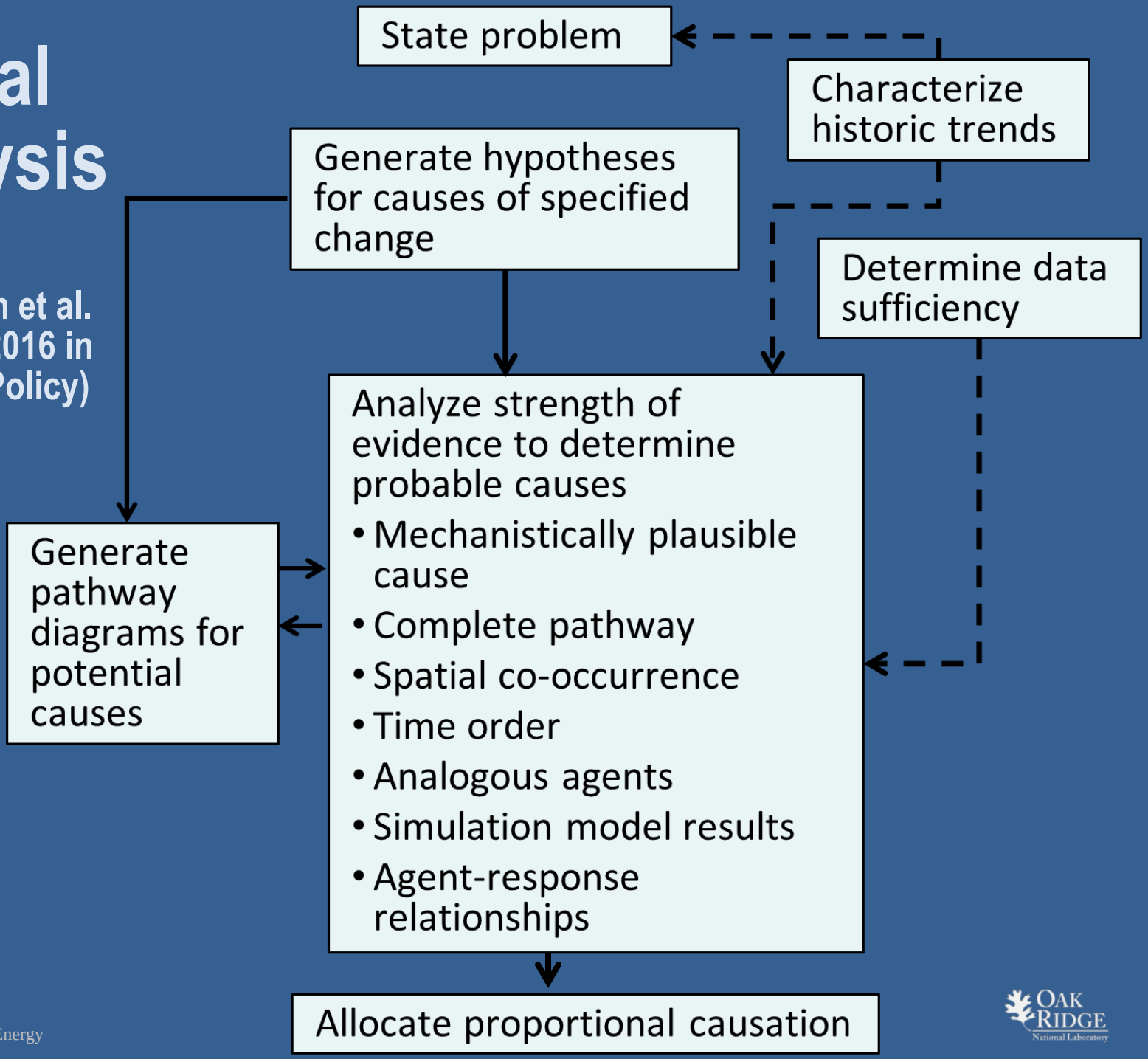
Socioeconomic indicators for bioenergy sustainability & associated ecosystem service

Category	Ecosystem service: type	Indicator
Social well-being	**Cultural services:** jobs and family income; **Provisioning service**: food	Employment
		Household income
		Work days lost due to injury
		Food security
Energy security	**Provisioning service:** energy	Energy security premium
		Fuel price volatility
External trade	**Provisioning services**: food, feed, fuel and fiber	Terms of trade
		Trade volume
Profitability	**Provisioning services**: food, feed, fuel and fiber	Return on investment (ROI)
		Net present value (NPV)
Resource conserva-tion	**Provisioning services:** fuel, chemicals, plastics	Depletion of non-renewable energy resources
		Fossil Energy Return on Investment (fossil EROI)
Social accepta-bility	**Provisioning services**: food, feed, fuel and fiber	Public opinion
		Transparency
		Effective stakeholder participation
		Risk of catastrophe

Dale et al. (2015; and 2016 in review)

Causal Analysis

(Efroymson et al. Accepted 2016 in Land Use Policy)



Policies to Boost Solid Biomass (IRENA)

- ***Accelerate improvement of crop yields***:
  - How to promote higher yields with low commodity prices to growers and 40% waste in food systems?
- Collect ***comprehensive data on land*** that could be used for sustainable ***wood and grass crops***, including likely yields.
  - Where is land the constraint? [not globally; see 2015 SCOPE report]
  - Do we understand how land management can accelerate carbon storage *AND* productivity, and strengthen terrestrial sinks? (e.g., Woodall et al. 2015)
- Research ***practices for cultivating rapidly growing trees and grasses*** on pastureland… – grown for what markets?
  - Millions of hectares of pasture burn each year to eliminate encroaching vegetation
- Institute ***more secure land tenure*** and ***better governance*** to provide incentives for more intensive land management. – ***YES !***
- Provide Incentives to plant ***trees on degraded lands.***
  - ***What incentives work best? Who benefits?***
  - ***Can markets provide the right signals?***
  - ***Is certification the answer?***

Policy suggestions from Jeff Skeer, IRENA, 2016 presentation, "Boosting Biofuels" in http://www.eubce.com/parallel-events/workshops/the-world-needs-more-land-use-change.html

IEA Bioenergy Joint Task Meeting Question: "Can certification ensure sustainability?"

"No" because –

1. Nothing can ***ensure*** sustainability.
2. There are many opportunities for substitution in biomass markets
3. Transaction costs for certification, monitoring and verification are high relative to the value of the product (biomass)
4. Uncertainties about sustaining political will and market premiums
5. Even well-designed schemes can be "gamed," and a few well-publicized cases undermine credibility.

Photo VH Dale, 2016: Logging residues in East TN left to rot or burn because there is no market for biomass-bioenergy.

IEA Joint Bioenergy Tasks Question: "Can certification *facilitate* sustainability?"

"Yes, it can *if it*" –

1. Is developed with users as a cost-effective tool that meets their needs
2. Provides feedback to guide production toward continual "improvement" from users' perspectives
3. Is designed to adapt to changing contexts and priorities
4. Is inclusive
5. Is supported by government, civil society, and financial incentives
6. Is based on clear and accepted standards

ASTM Standard Practice for Assessing Relative Sustainability (2016 draft, Committee E48)

- Guidance on process for assessments:
  - relevance to local needs
  - information necessary to support continual improvement
  - replicable, measurable and verifiable indicators: and
  - support fair comparisons and informed choices.
- Certification schemes can differentiate products but
  - Are outcomes – documents and labels – what society really wants?
  - Who benefits?

Photos of mixed cropping strategies in Haiti (top, photo by R.Savage) and Mexico (bottom, K.Kline)

See: https://www.astm.org/COMMITTEE/E48.htm

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD >160 indicators

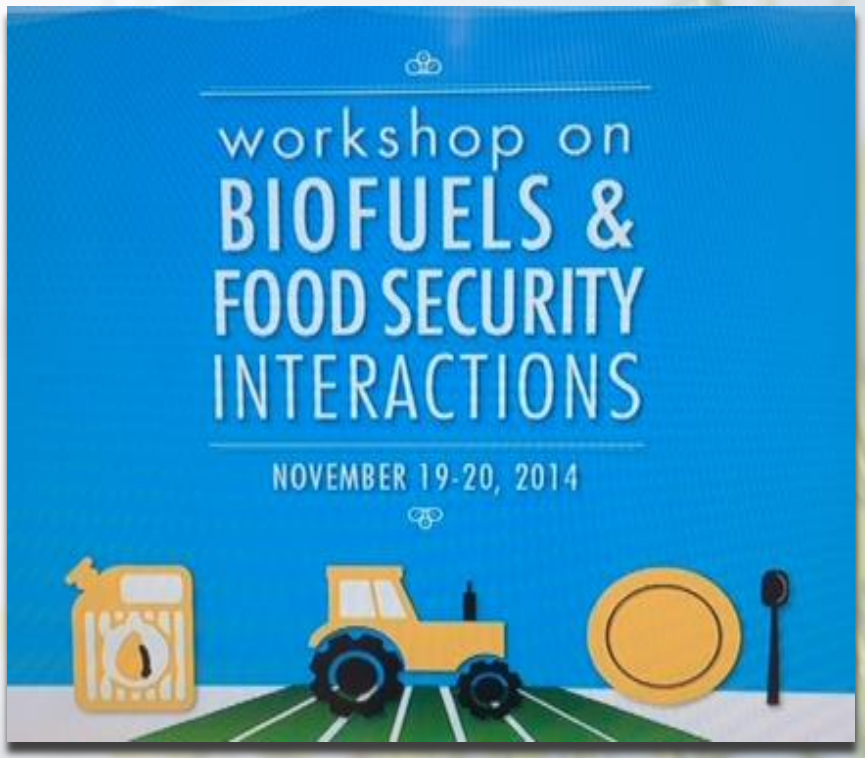
http://sd.iisd.org/news/iaeg-sdgs-sets-workplan-for-finalizing-indicators/

Sustainable bioeconomy contributes to SDGs✓ related to: food security and nutrition (**Goal 2**), healthy lives (**Goal 3**), water and sanitation (**Goal 6**), affordable and clean energy (**Goal 7**), sustainable consumption and production (**Goal 12**), climate change (**Goal 13**), oceans, seas and marine resources (**Goal 14**), and terrestrial eco-systems, forests, desertification, land degradation, and biodiversity (**Goal 15**).

Food security

International workshop set forth key issues*

- **Identify synergies – for example**
  - Flex crops (can be used for food or fuel)
  - Infrastructure in rural areas supports food & fuel
  - Sustainability is key to both
- **Frame the problem: Ask the questions that matter**
- **Use clear terminology**
  - See workshop report (link below) and forthcoming publication in GCB-Bioenergy



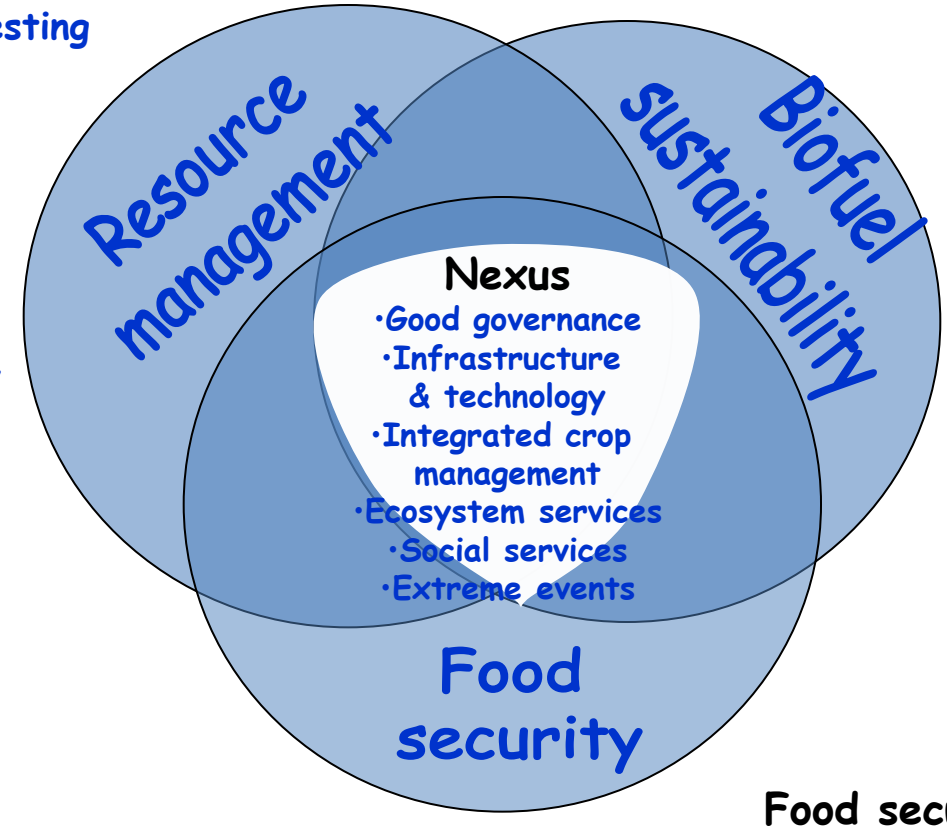
* http://www.ifpri.org/event/workshop-biofuels-and-food-security-interactions

Resource management ➢ Biofuel sustainability

- Increased efficiency & productivity of biomass
- Opportunities & constraints on locations for planting & harvesting

Biofuel sustainability ➢ Resource management

- Reduced greenhouse gas emissions
- Attention to land-use planning & biodiversity
- Incentives for restoration



Resource management ➢ Food security

- Good management underpins food security
- Increased efficiency & productivity of food
- Place-based opportunities & constraints

Biofuel sustainability ➢ Food security

- Income enhancement & diversification
- Energy for food production, processing, & transportation
- Reduced volatility in market prices
- Enhanced sustainability of food crops

Food security ➢ Resource management

- Secure, healthy diet is a prerequisite for management
- Incentives for restoration
- Reduced pressure on marginal lands

Food security ➢ Biofuel sustainability

- Oversupply cushion required for food security
- Healthy workforce underpins biomass markets

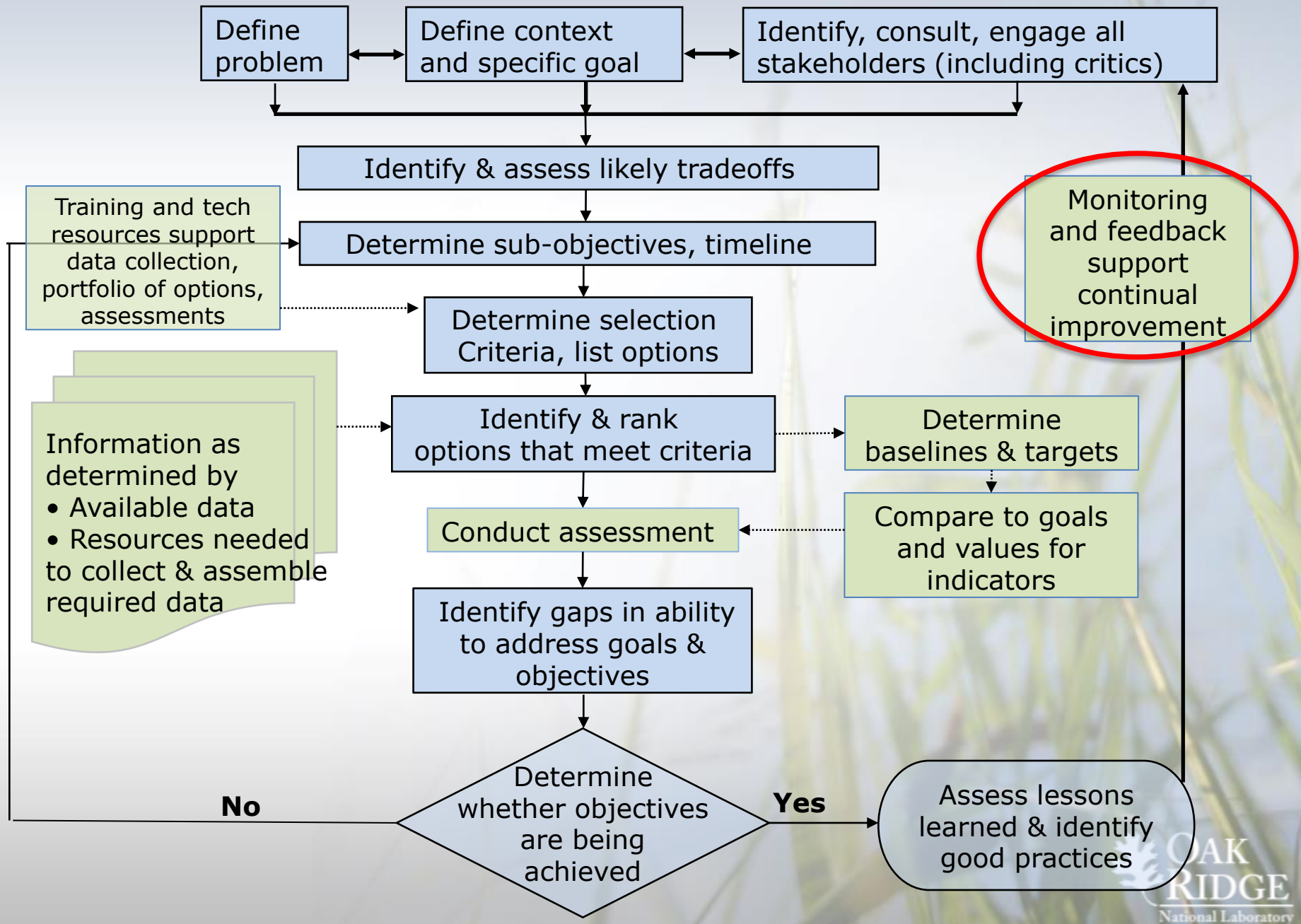
Kline et al. 2016 GCB-Bioenergy http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12366/full

ASTM Standard Practice for Assessing Relative Sustainability

Principles:

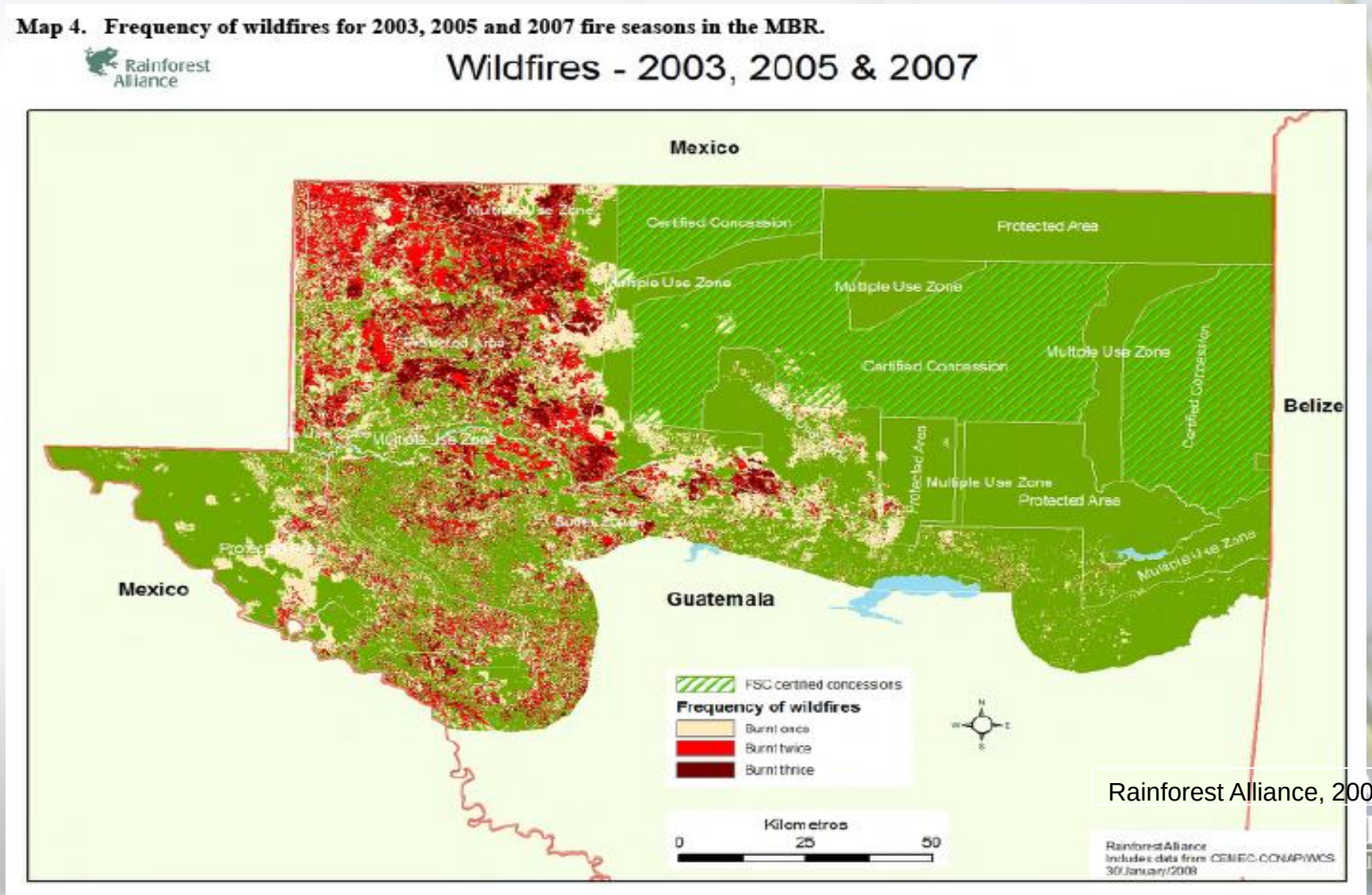
1. Sustainability is always a relative proposition involving choices between options or development trajectories;
2. An option can be determined to be favorable compared to another when both options are assessed using appropriate criteria and indicators;
3. The selection of criteria and indicators is not pre-determined but depends on local context, stakeholders, costs, data availability and project goals; and
4. Sustainability involves a transparent and iterative process of problem definition, stakeholder engagement, goal-setting, monitoring, adjustment, and reassessment to promote continual improvement.

Framework to Support More Sustainable Outcomes



Dale, Efroymson, Kline, Davitt (2015) A framework for selecting indicators of bioenergy sustainability. Biofuels, Bioproducts & Biorefining 9(4):435-416

Fires and deforestation in Maya Biosphere Reserve, Guatemala. Habitat loss, contamination of water and soil, and new settlements are legacies of oil, not agriculture.



Steps to encourage beneficial LUC

- Legal and financial motivations to invest in and adopt better management practices
- Pathways to "natural climate mitigation"
  - Better management of occupied lands
  - Conserve remaining forests (no new roads!)
  - Restore and replant former forest lands
  - Create value-added jobs and services that reduce pressure on isolated forest frontiers (reduced deforestation) in LDCs
- Give biomass value! Reduce losses
  - Fires and other disturbances
  - Wastes
- Accelerate shifts to ever higher performing urban and integrated agro-silvo-pastoral systems
- Increase scrutiny, awareness and enforcement to end illicit land-management activities
- Apply same performance criteria to all sources of energy and all land management (food, feed, fiber, energy…)

Conclusion: Plenty of biomass, inadequate rewards for good management







We need to

- Learn from experiences
- Build local partnerships
- Develop and apply a suite of metrics that reflect local stakeholder priorities for "sustainability"

Source: Kline training seminar for Advanced School on Present and Future of BioEnergy; ESPCA – FAPESP – University of Campinas, 10-17 October, 2014. Campinas, SP Brazil.

Thank you

Center for Bioenergy Sustainability

http://www.ornl.gov/sci/ees/cbes/

See CBES website for

- Reports
- Forums on current topics
- Recent publications

Most recent paper, Reconciling food security and biofuels" out 14 June 2016: http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12366/full

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OAK RIDGE National Laboratory

Prologue. A song:
What the world needs now is land-use change
Not what you were thinking of but the kind we all can love

What the world needs now is land-use change
Growing more crops and trees can provide for many needs

What our lands need now is science-based care & love
That's the only thing that there's just too little of...

To the tune of, "What the world needs now is love," by J.Deshannon.
With apologies to Jackie Deshannon, author of original lyrics (below). Note: the original lyrics are great and were on my mind when we conceptualized this workshop. -KK

What the world needs now is love, sweet love, It's the only thing that there's just too little of
What the world needs now is love, sweet love, No, not just for some but for everyone…

Lord, we don't need another meadow
There are cornfields and wheat fields enough to grow
There are sunbeams and moonbeams enough to shine
Oh, listen, lord, if you want to know

What the world needs now is love, sweet love
It's the only thing that there's just too little of
What the world needs now is love, sweet love
No, not just for some, oh, but just for ever, every, everyone

Epilogue for scientists: Are we in the right field?

"I used to think the top environmental problems were

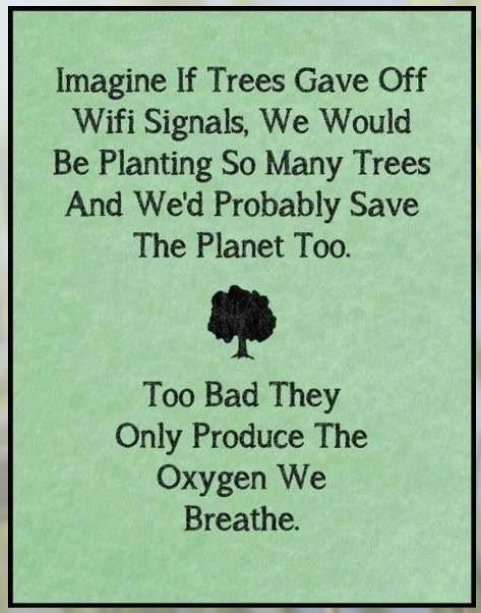
- *Biodiversity loss*
- *Ecosystem collapse*
- *Climate change*

And thought science could address these problems.

I was wrong.

The top environmental problems are greed and apathy, and to deal with those we need a cultural, spiritual transformation. Scientists don't know how to do that."

– attributed to Gus Speth



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BETO Bioenergy research at ORNL-CBES

- Advance common definitions of environmental & socioeconomic costs & benefits of bioenergy systems
- Quantify opportunities, risks, & tradeoffs associated with bioenergy production in specific contexts
- Support efforts to improve stainability assessment via agreements on definitions, criteria, baseline & targets & a manageable set of relevant indicators
- Support improved standards, recognizing that c*ertification ≠ sustainability*

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Enable long-term supply of renewable biomass for clean, domestic bioenergy