Bioenergy and biodiversity: Key lessons from the Pan American Region

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To keep in mind for discussion:

What are priority research needs for biodiversity – that are relevant to Pan America bioenergy development?

Costs and benefits of bioenergy to biodiversity

Costs

- Land cover/management change
  - LC change -> loss of habitat: a major threat to biodiversity
  - Expansion into natural areas = less area for biodiversity support
  - Species-area curve predicts decline in species with less available habitat
- Decreased ecosystem services/ functioning
  - Nutrient cycling, water filtration
- Unsustainable biomass harvests

Benefits

- Land cover/management change
- Climate change mitigation
  - Climate change is a major threat to biodiversity
- Some bioenergy crops can provide habitat and improve ecosystem services/ functioning
  - Advanced or "2nd generation" biofuels
- Biomass can be managed in ways that are sustainable and help conserve habitat
  - Increased value of ecosystem

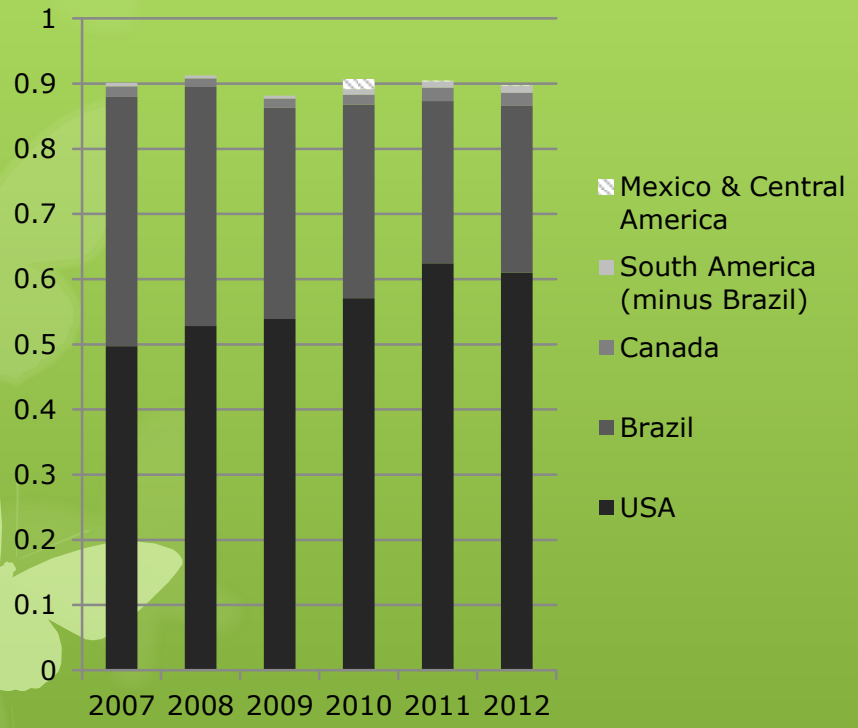
Bioenergy mandates and biodiversity protection laws

- Many countries have laws protecting biodiversity (e.g., Endangered Species Act in the US), nature reserves and parks, air and water quality (ecosystem services)
- 14 countries in Pan American region have legislation promoting biofuel blends or bioenergy production
  - USA: blending requirements by state, federal level production targets
  - http://www.biofuelsdigest.com/bdigest/2013/12/31/biofuels-mandates-around-the-world-2014/

Country	Blending targets
Argentina	B10, E5
Brazil	E20, B5
Canada	E5 (<E8.5), B2
Columbia	E8
Chile	E5, B5
Costa Rica	E7, B20
Ecuador	B5
Jamaica	E10
Mexico	E2
Panama	E5
Paraguay	E24, B1
Peru	E7.8, B2
Uruguay	E5 and B5 by 2015
USA	Varies by state

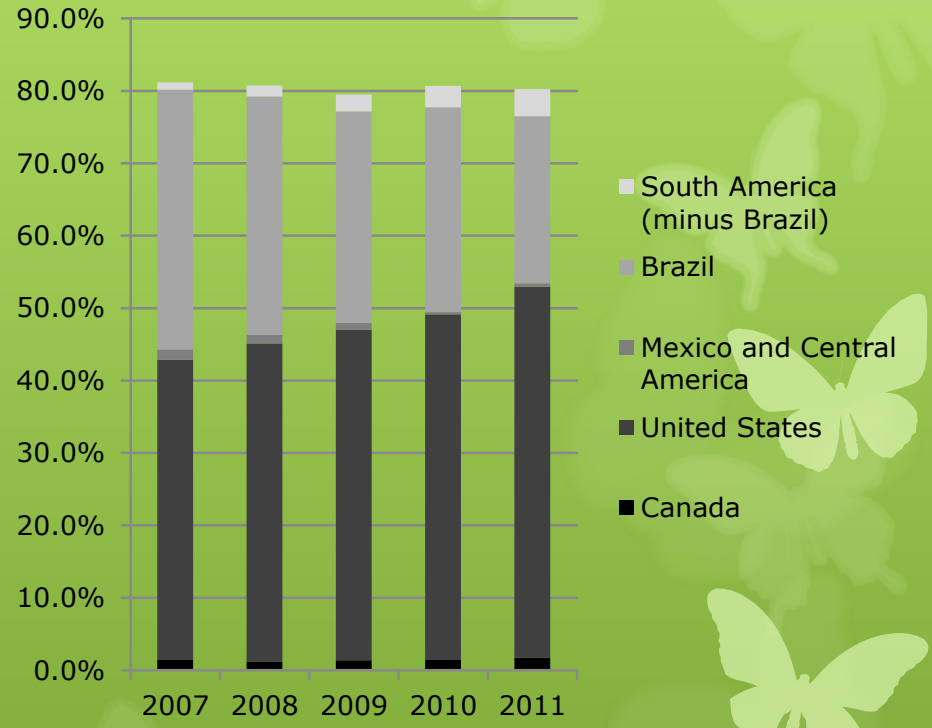
Biofuels production in Pan America

Percent of world bioethanol production, by volume



www.ethanolrfa.org/pages/annual-industry-outlook

Percent of total global biofuels production, by volume



http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=79&pid=79&aid=1

Wood Pellets in British Columbia, Canada

- Canada: produces 3 million tonnes per year
- British Columbia: 66% of Canadian pellet production
  - Feedstock from 22 million ha of public forests, 2 million ha private forests
    - 80-95% of feedstock from industrial residues, plus tops and branches post-harvest
  - 94% of pellets exported to Europe

Wood Pellets in British Columbia, Canada

- Benefits: reduction in debris and slash piles facilitates replanting after harvest and reduces fire risk
- Public forests required compliance with management guidelines; monitoring by interested parties
- Biodiversity concerns are primarily related to possible future changes in practices:
  - Deadwood collection
  - Excessive collection of coarse woody debris may negatively impact beetles, woodpeckers, and other deadwood obligates
  - Forests infested with mountain pine beetle could become targets for chips and pellets
    - At present this is not considered to be economically viable

Biofuels in the United States

- Prior research and initial implementation of renewable fuel mandates focused primarily on ethanol from corn (maize)
  - Rapid growth in production required little change in machinery, methodology, infrastructure
- New research to facilitate shift to advanced or 2nd gen feedstocks:
    - Perennial grasses (switchgrass, miscanthus), fast-growing deciduous trees (hybrid poplar, hybrid willow)
      - Many options for integration with existing systems
        - Buffer strips, riparian zones
        - Inter-cropping
        - Winter cover crops and biomass rotations
        - Mono-culture perennials…
    - Harvest residues (tree tops and branches, corn stover)

Biofuels in the United States

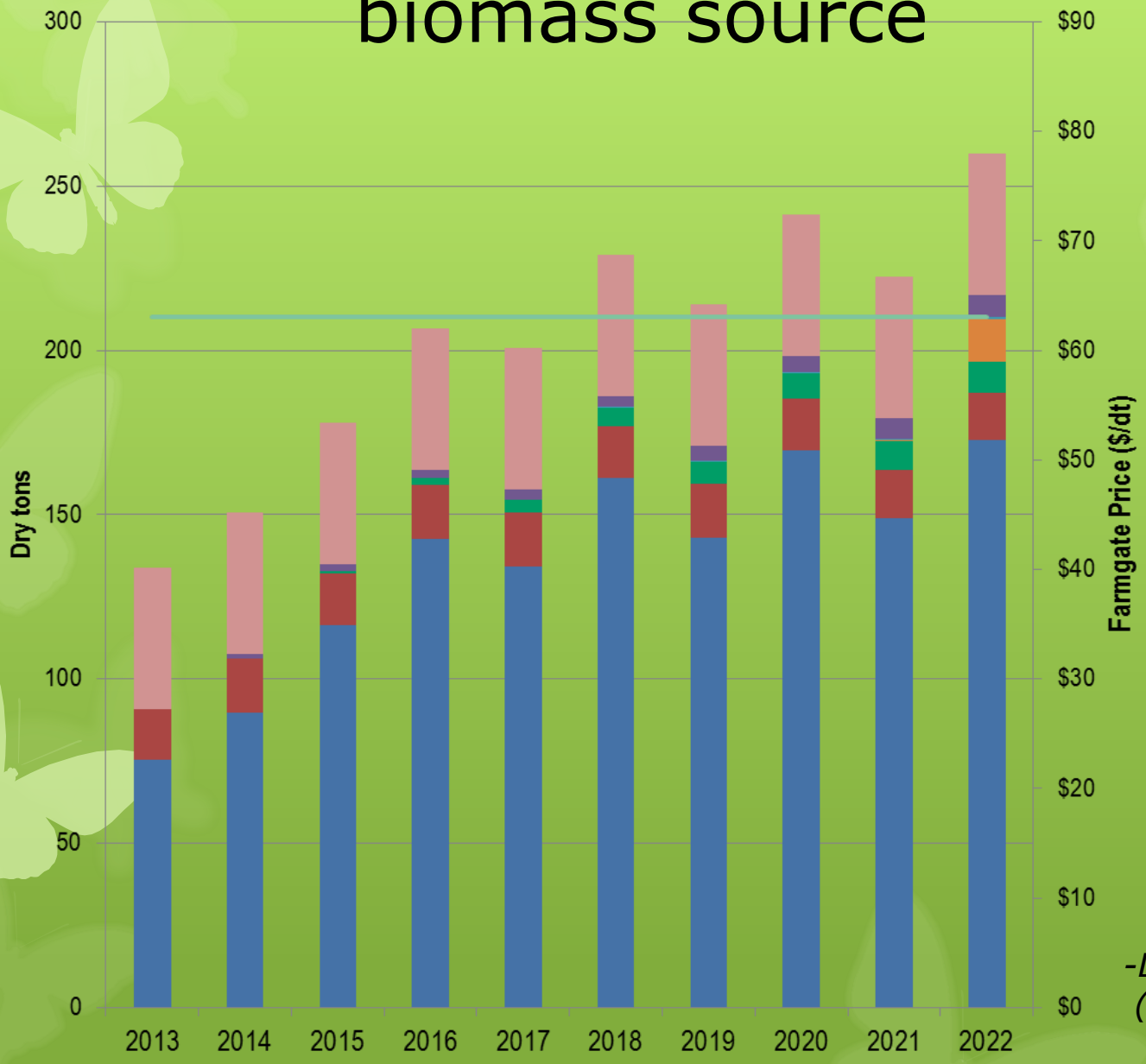
- Comparison of biodiversity impacts of grain-based biofuels versus 2nd generation biofuels:
  - Biodiversity supported is higher in and around second-generation
    - Landscape-level heterogeneity
    - Reduction in negative impact to aquatic systems
    - Still concern about impacts of conversion of natural cover or "marginal" land
  - Second generation plots provide ecosystem services
    - Water filtration
    - Soil stabilization
    - Habitat (breeding, feeding, stopover) for some species

U.S. Bioenergy supply model Billion Ton Update (USDOE 2011)

- Forecasts of potential biomass
  - POLYSYS partial equilibrium model of US agricultural and forestry sectors.
  - 20-year projections of economic availability of biomass (price, location, scenario)
- Forest resources
  - Logging residues
  - Forest thinnings (fuel treatments)
  - Conventional wood
  - Fuelwood
  - Primary mill residues
  - Secondary mill residues
  - Pulping liquors
  - Urban wood residues

- Agricultural resources
  - Crop residues
  - Grains to biofuels
  - Perennial grasses
  - Perennial woody crops
  - Animal manures
  - Food/feed processing residues
  - MSW and landfill gases
  - Annual energy crop (added for 2011 Update)

Residues projected as primary US biomass source



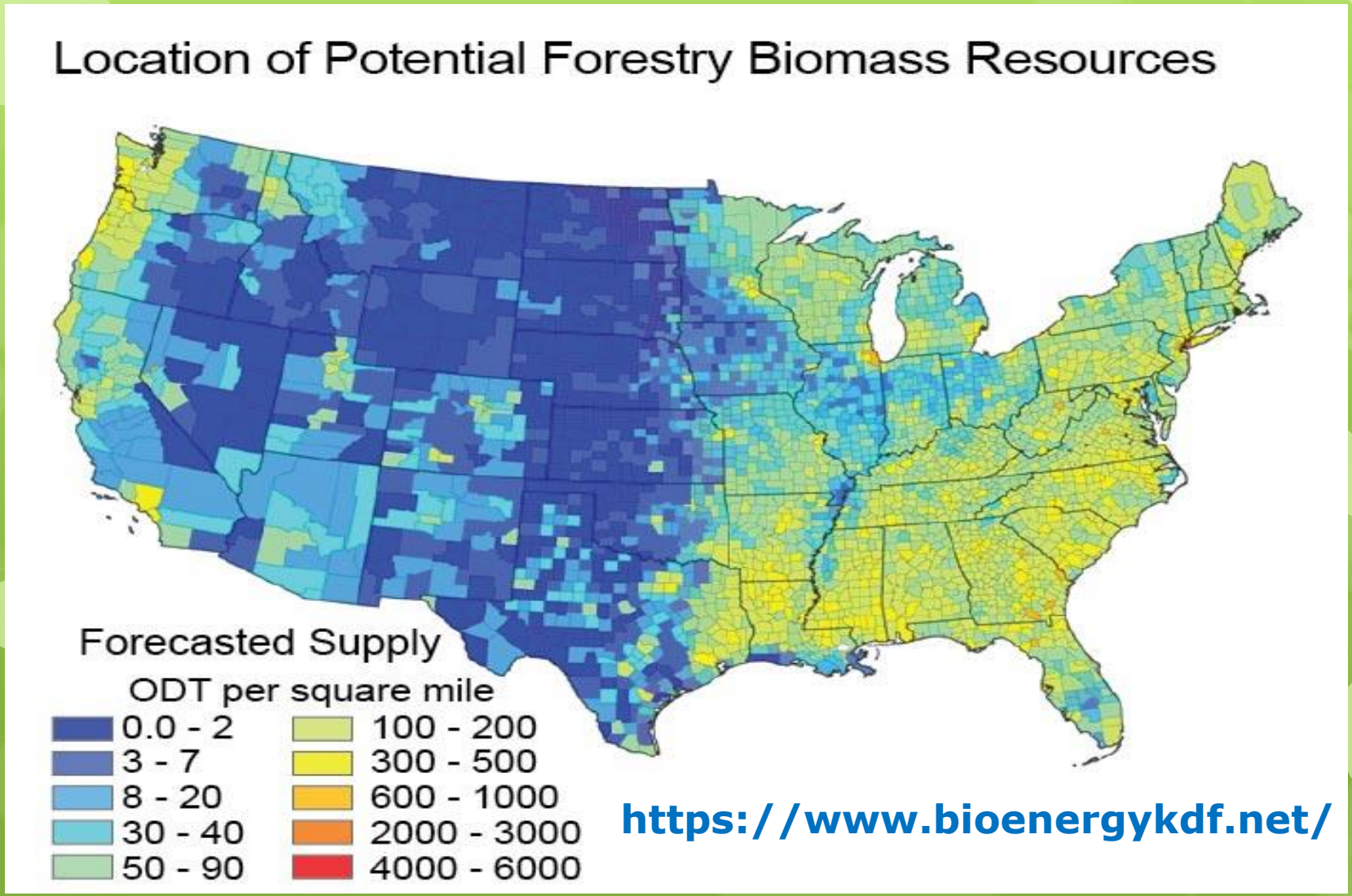
Resource profile at $63 dry ton^{-1} which provides 250 million dry tons by 2022 (meeting EISA target).

-Langholtz et al. (2014, BioFPR)

Biofuels in the United States

Focus now on where, how much, at what cost, which feedstocks

Source: Department of Energy Knowledge Discovery Framework (Bioenergy KDF)



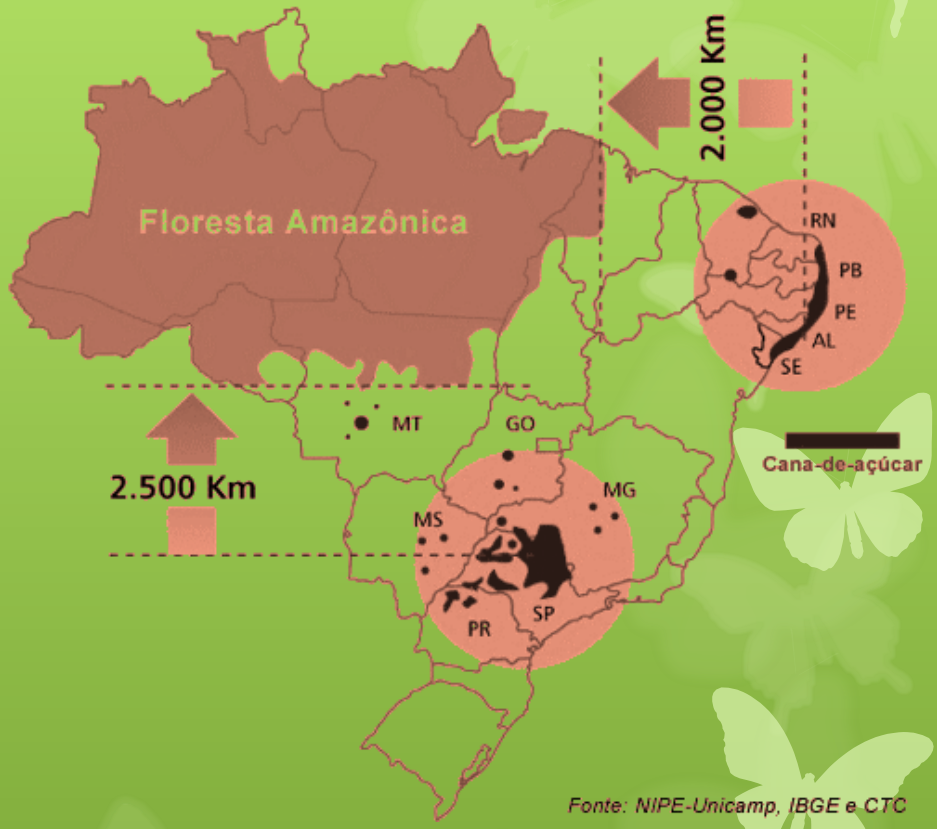
Biofuels in Brazil

Dynamics of land use governed by expansion and consolidation phases

- Expansion: extraction, deforestation, pasture, agriculture
  - Complicated land tenure, socioeconomics
  - Ag production secondary: less specialized; extensive
- Consolidation: increasingly specialized, intensive agriculture
  - Supported by infrastructure (roads and bridges)
  - Increased land values requires greater returns
  - Sugarcane, soy and palm oil for biofuels
- Policies needed to avoid further damage to key biodiversity/ high conservation value (HCV) areas
  - Cerrado (savannah region) under intense development pressure now

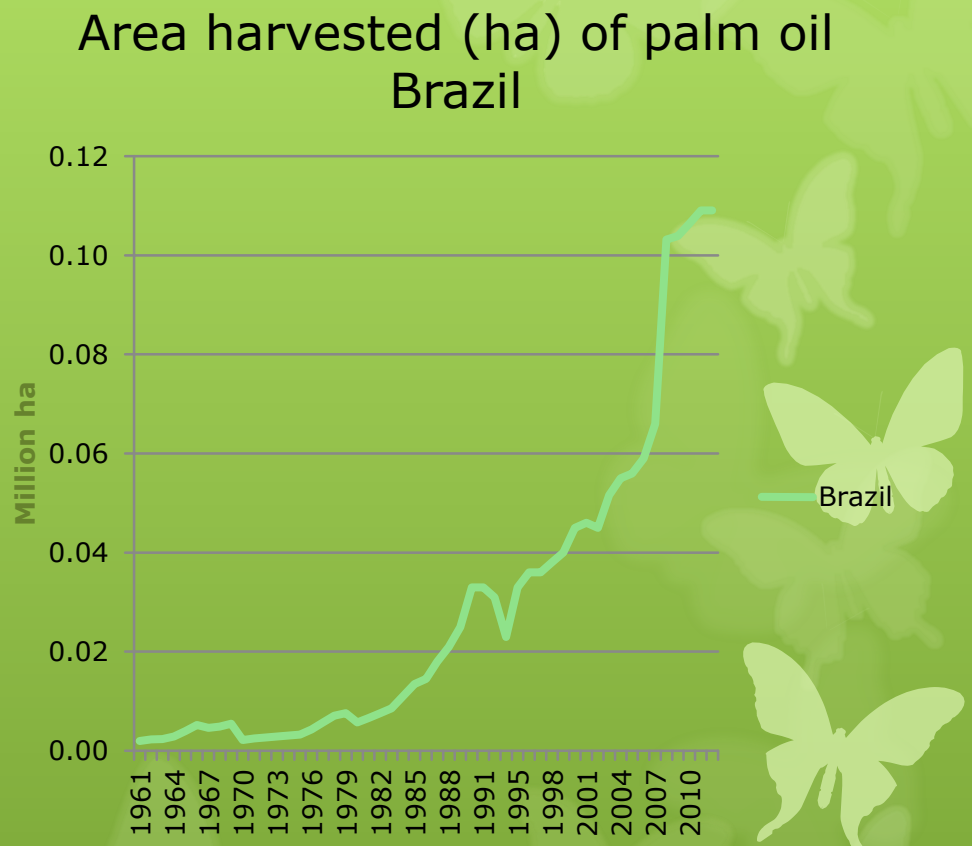
Biofuels in Brazil: sugarcane

- Sugarcane has been grown in Brazil for 500 years
- Most sugarcane is far from Amazon
- To address concerns about LUC, Brazil government developed Agro-Ecological Zoning for sugarcane
  - Focus on former pasture lands
  - Concerns remain about expansion into Cerrado



Biofuels in Brazil: Palm Oil

- Agro-Ecological Zoning aims to restrict new palm oil plantations to previously degrade lands
- Some concerns remain in Pará region – area of rapid growth – with high biodiversity and endemism, endangered
  - Potential effects on water quality
  - Other effects of development in rural areas



Biodiversity protection through Certification

	RSB	ISCC	Bonsucro
Biodiversity Principle	Avoid high biodiversity areas	Avoid high biodiversity areas	Actively manage for biodiversity
Issues addressed	Ecosystem services, corridors	biodiverse grasslands, carbon stocks, peatlands	Assessment of impacts, mitigation measures
No-go areas	Addressed	Indirectly addressed	Assumes existing plantations only
HCV	Yes	Yes	Yes
Degraded lands	Used to be	No	Yes
Invasive species	Yes	Yes	Yes
Threatened species	Yes	Yes	Yes

Pan-American Patterns

- Concern for biodiversity and ecosystem protection is explicit – legal and enforcement mechanisms improving
- Advances in identifying bioenergy production systems that are more harmonious with natural habitats and conservation goals
- Policies restricting bioenergy production to less diverse, already disturbed, and marginal lands
- Most growth and new development is NOT driven by bioenergy per se
  - Successful feedstocks have large non-energy markets
    - Bioenergy is one of several, minor, co-products
  - Bioenergy incentives – when they exist – tend to support large industrial interests
  - Difficult for new crops/technologies to penetrate fuel markets, especially if dependent on biofuel market alone.

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Thank you

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