LCLUC Impacts:

Notes and Actions from Discussion at the LCLUC Science Team Meeting April 3-5, 2000

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Synthesis of Results from the 1st round of funded research proposals

Through an assessment of presentations and results, we identified some apparent common themes, which may be self evident to some but are nevertheless fairly coherent. Drivers, impacts, and feedbacks are highly variable across scale and region. Nevertheless, the landscapes studied in these projects fall into certain broad categories that we characterize as LCLUC Condition. These are defined as:

- Undisturbed: landscape that is dominated by natural cover types, where change is primarily by natural disturbance

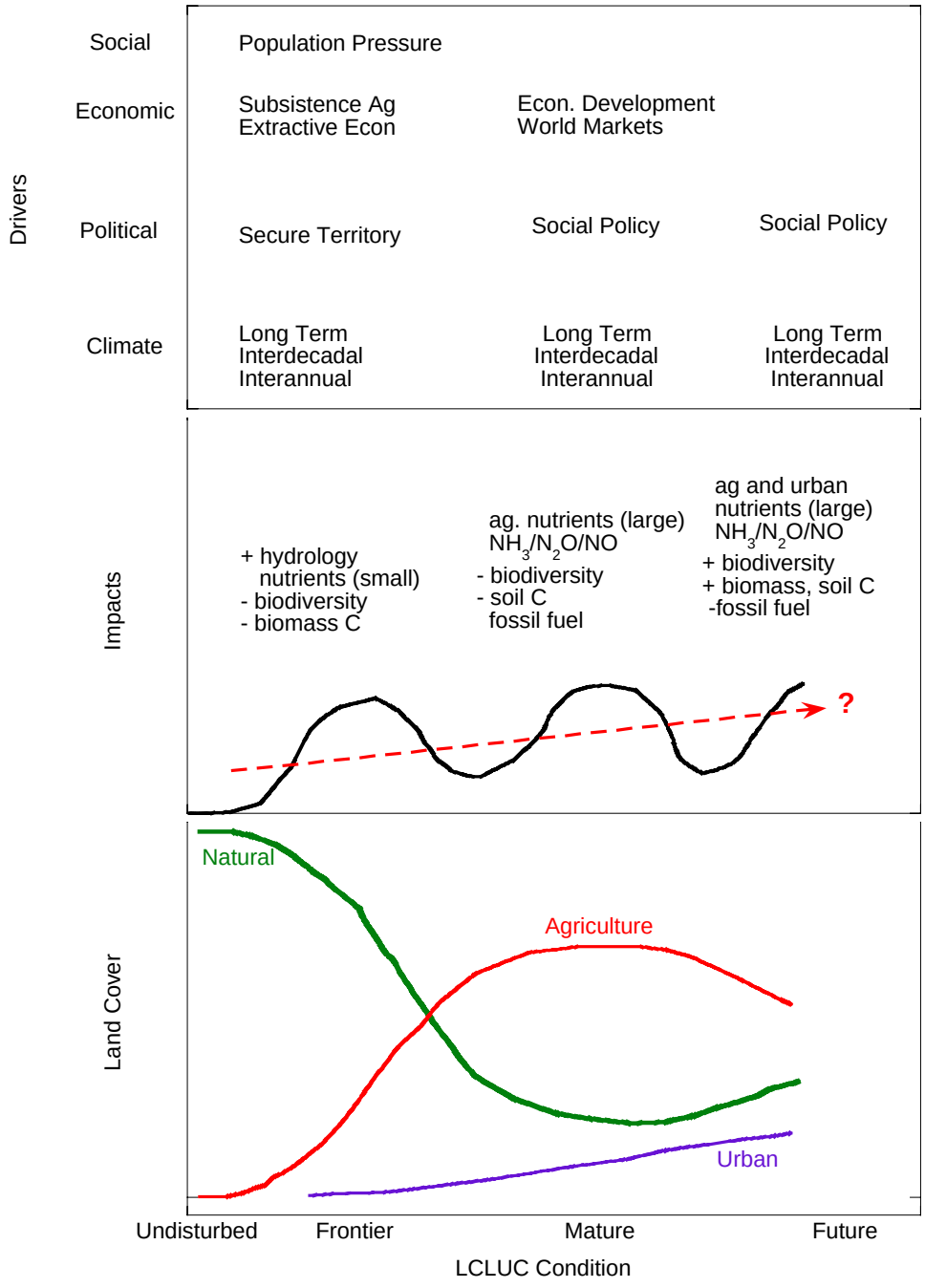
- Frontier: Landscape that is exhibiting transformations in natural cover (e.g. to agriculture, to regrowth through resource extraction) that can be rapid and widespread

- Mature: Basic distribution of land cover and land use units is relatively stable, changes in land cover are slow, while changes in use may be characterized by intensification. Urbanization has occurred causing increases in natural cover (early) or fragmentation of natural cover (late)

It is the transition between these landscape conditions, as well as forces (drivers) occurring within a condition that determine the impacts that are felt locally, regionally, and globally. For example, the transition from an undisturbed to a frontier landscape could be motivated at a national level by population pressures in a mature landscape or the desire to secure sovereignty over land. (other drivers across scale could be inserted here, e.g. policies to subsidize extractive economy or to motivate individuals to develop subsistence or market agriculture) The impacts from this transformation and activity include very evident biogeochemical and physical changes in the landscape (hydrology, nutrients, erosion, biodiversity, biomass carbon, etc.) as well as changes in vulnerability to interannual and interdecadal climate variability (El Niño and fire).

In a mature landscape, the drivers, impacts, and feedbacks are somewhat different. With development of urbanization, there is abandonment of agricultural lands as well as consolidation of the most productive lands. This leads to reforestation of some lands, as well as intensification in remaining agricultural lands. The drivers under these conditions may be economic development, social policies, raising of living standards and movement to industrial and service economies. Impacts here may include large changes in hydrology and nutrient flux through the water system, decreases or increases in biodiversity, etc.

A highly generalized synthesis of these concepts can be see in the following figure:



East US	1600	1700	1900	2000	2050
West US	1800	1900	2000		
Amazonia	1950	2000			
Siberia	2000				

Quantifying Impacts:
Scale becomes an extremely important issue when the matter of quantifying impacts is assessed. Impacts that can be identified and characterized at a global or regional scale have had a great effect in framing questions and pointing to the magnitude of some problems (e.g. deforestation, degradation, drought). Nevertheless, detailed characterization and quantification of impacts have generally relied on higher resolution observations typically at the scale of Landsat TM. This dichotomy of scale clearly hampers fundamental understanding of LCLUC processes and impacts (forest vs trees issues). In the NASA LCLUC program, most of the analyses are TM-based, and while clearly critical to identify LCLUC pathways and impacts, still need to consider how this feeds into the regional view. The advent of more high spatial resolution sensors and more frequent observations coupled with expanding capacity to analyze data will likely lead to a better merging of these approaches in the future. This needs to be properly articulated and demonstrated. (Figure of Spatial Scale vs Spatial Resolution is appropriate here).

What impacts exactly can be quantified? When considering the range of presentations and results, it seems clear that in regions with rapid and distinct changes in land cover (e.g. forest to cleared/agriculture, agriculture to urban), rates, patterns, and trajectories can be quantified by the current approaches. Changes in the biophysical properties of the surface (e.g. live cover in semi-arid regions, woody vegetation encroachment) can also be quantified with some measure of success (sometimes referred to as continuous fields). Aspects of intensification and changes in some land use, as well as land cover state (e.g. health) are possible though this has not been widely demonstrated. In some respects, this type of LCLUC may be dependent on models and empirical relationships instead of direct parameterization. In addition, this may be dependent on incorporation of in situ and socio-economic data to model impacts.

Precision and accuracy figure heavily in the rational use of quantified impacts as described above. A greater emphasis is needed to do proper error assessment, including bias. Monitoring is also an important need. By definition, impact requires a knowledge of a previous state. Specific impacts will vary spatially and temporally, and thus monitoring must be designed to capture these scales. Critical questions remain regarding the design of monitoring programs, the relevant variables that must be observed, and these will also require a greater understanding of relevant impacts: what are the relevant impacts?

An ultimate goal of the LCLUC program is to affect policy. The future, however, is hard to predict. What will the effect of specific policies be? How will climate variability resonate with policy and human action? While significant uncertainty exists, the broad framework emerging from the LCLUC program provides a structure to at least consider what the impacts might be. Through the specific examples of the case studies and the cross-cutting themes that emerge from these studies, we are closing in on being able to articulate options and their outcomes.