Climate change, its impacts and carbon sequestration

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Carbon sequestration

Vegetation in dryland Africa is the result of a long term coexistence between human populations and nature. Savannah ecosystems, in particular Guinea and Sudan savannahs, are so called “fire climax” ecosystems, where the existence and extend of woody tree cover is regulated by the frequency and severity of fires in the area. Many, especially more humid, savannah ecosystems will close up and become semi-closed (or even closed) forest if fire is excluded. Current land use trends, however, seem to rather increase the degradation of these ecosystems into treeless grasslands.

Research from a Savannah in America (San Jose et al. 2000 Forest Ecology and Management 105:251-262) shows that carbon sequestration in such an ecosystem will increase, once fire is excluded (with carbon sequestration being around 1.4 tn C ha^{-1} yr^{-1}. My own sparse observations from some plots in Africa point into the same direction.

There are, however, other ways to increase carbon storage in dryland ecosystems. These are changes on agricultural technologies (i.e. no tilling agriculture), use of more productive agricultural technologies (i.e. improved pastures, rotational grazing) and agroforesty systems.

In the Clean Development Mechanism (CDM) there was originally the option to make of carbon sequestration from these activities tradable environmental services. Thereafter, all these options but afforestation (and possibly agroforestry) were dropped from the CDM.

Current prospects for afforestation carbon sequestration projects are somehow dim, while the market price for CDM derived carbon is somehow low (<10 US $ per ton of carbon) the transaction costs for CDM forestry projects seem to be high. A recent survey in Central America mentions that about 70 000 US $ are required for project certification and registration. This would make successful projects very large and might be difficult considering the complex land holdership issues in Africa. Also, it is not clear how questions of permanence of carbon sequestration will be solved for afforestation projects (i.e. the questions how to avoid, account for possible deforestation of previously afforestated areas after the end of the project). Also, large scale afforestation projects (particularly projects based on exotics) have yielded critics from environmental NGOs.

Another option would be afforestation based energy projects. There small projects could be more easily accepted under the CDM and for small projects simplified acceptance procedures are possible.

Climate change impacts on African drylands

Climate change will affect growth of forests in the African drylands in two different ways:

- Decreasing precipitation and increasing temperature could decrease production of forests. However, it is not clear to what extend rainfall will decrease and if increased temperatures are really associated in increases in evaporative demand. (Roderick and Farquhar Science 2002).
- Increases in CO_2 may increase forest production, especially under moderate drought.

These changes would bring about changes in vegetation productivity and vegetation structure, like shifts in species composition. An interesting point is that African savannah ecosystems are usually composed of two main components: C4 grass species and trees (that have a C3 type of photosynthesis). Now, C4 species do not increases production as a result of increased CO_2 concentrations while C3 species do. Therefore, increasing CO_2 concentrations without climate change would increase the production of the tree component, but not the grass component of savannah. This means also that increased CO_2 per se will not increase fuel production in grassland dominated savannah ecosystems.

While rainfall predictions for much of Africa are not clear it is arguable what will be responses of vegetation in total and I would suggests that the discussion should focus on management issues to mitigate effects of climate change locally. An obvious danger (even under an increased rainfall scenario) is an increase in desertification due to poor resource management / over-exploitation of the resources.

Altogether, current climate predictions are not clear for most of the Sahel. In eastern Africa rainfall and ecosystem resilience might increase, while it would decrease for southernmost Africa.

Altogether this shows that there is no clear picture on the effects of climate change on African dryland ecosystem. These ecosystems are, however, in every case very vulnerable and future management will largely determine the fate of these ecosystems. Climate, on the other hand, has a large role to define how much “human induced stress” the ecosystem can cover with.

Questions:

What is the current interest of land managers in dryland Africa to “sell carbon sequestration” (i.e. to what extend land managers would be ready to go through the bureaucratic procedures in order to receive a smallish increase in funding for restoration projects?

Is the idea of increasing resilience of ecosystems through management (i.e. early season fires, tree planting, rotational grazing and protection of natural vegetation) seen as a measure to mitigate possible effects of climate change.