A land cover/use collision course: pressures of agricultural development and land protection in Tanzania

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>\ An open landscape?

Miombo woodlands amidst agricultural villages, Tabora Province, TZ Field visit Jan 2012 – photo M. Mayes

Agricultural development and environmental conservation in Tanzania

-Agriculture contributes 85% of national GDP, tourism ~10%

-Land resources under increased development pressure from agricultural development interests

-Current state and nature of land resources?

-Nature of local and regional community livelihoods?

-Tradeoffs of future development: Food, biofuels, enhancing protected areas?

Sources: Oakland Institute: Understanding Land Investment Deals in Tanzania Report, 2010: http://www.commun.com/commun.com/commun.com/commun.com/commun.com/commun.com/commun.com/commun.com/commun.com/ Tanzania Business Times, Economic and Financial Weekly, Mnaku Mbani, 4 March 2011:

Lack of data on the lands where development is occurring

"...the Ministry of Lands doesn't know where all the investors are. We are lacking information...there is confusion across ministries...everybody is still learning about investors and land management and agricultural practices by foreign investors on [what was] previously Village Land...and we have no best practice yet."

Ministry of Lands Officer, direct communication to Oakland Institute, 2010

Source: Oakland Institute: Understanding Land Investment Deals in Tanzania Report, 2010: Quote from

My research questions:

Part I:

-How much land, where, is being actively developed for large-scale agriculture in Tanzania, and how much is "protected"?

*Differentiating land cover in Tanzania via use of satellite remote sensing techniques?

Part II:

-Where do agricultural development and "protected" areas overlap?

[Building towards...]

Part III:

-What are the consequences, for people and environment, of alternative development scenarios in areas with land use overlaps?

Part I: What is the state of current land cover? Remote sensing for: "How much land, and where?"



low vegetation



Field Site: Mbola, Tabora Province, Tanzania

Site visit during January 2012 Photo: M. Mayes

"Toto, we're not in Brazil anymore..."

Household farms (1-3 ha), intermediate elevations



Upland forest

Lowland forest

Tobacco field ~1-2 ha

Forest and agriculture site annual greenness phenology 2001-2010, Tabora, TZ (model for using technique in other areas of Tanzania)



-Ways to distinguish the curves: amplitude, frequency, average values during certain points in the cycle...

- Example hypothesis: "Plant responses to water availability at the start of the growing season (Oct-Nov) result in lowland forests greening up first, followed by upland forests, and finally, agriculture."





Climate and vegetation productivity across land cover regions

*understanding "base-case" forest landscape carbon cycles is necessary for studying how its replacement by agriculture could affect carbon storage, landscape responses to climate change



Part I: What is the state of current land cover? Remote sensing for: "How much land, and where?"

Next steps:

-Field work in Tabora: land use history, reference sites, veg. and microclimate data

-Landsat reflectances of land cover classes

-Multi-scale satellite analyses of coastal areas with more large-scale ag development



Part II: Where do agricultural development and "protected" areas overlap? Nature of land resources?

Geospatial analyses using diverse data:

NGO white papers: -Tabular data on land acquisitions (WWF, Oakland Institute)

<u>Open-source GIS data on:</u> -Admin. bounds -Protected areas -Land resources – soils (WWF, Protected Planet, FAO)







Agricultural development in Tanzania:

SAGCOT SOUTHERN AGRICULTURAL GROWTH CORRIDOR OF TANZANIA

SAGCOT Development Corridor (dark green), unveiled at the African World Economic Form, May 2010

TZ Agriculture: -25% of national GDP -85% of exports -80% of jobs

-Currently dominated by farming households, 0.9-3 ha

-Targeted for development by national government

-Many interested international investors (nations, companies)

Sources: Oakland Institute, 2010 http://www.oaklandinstitute.org/understanding-landinvestment-deals-africa-tanzania. SAGCOT Concept Note, 2010: http://www.sagcot.com/home/





Small-holder agriculture operations in Tabora, TZ, Jan 2012

Left – maize Below --rice





Above: Chinese-sponsored road-building, Tabora

Left: 8,200-ha Jatropha biofuel plantation, Kisarawe District

Kisarawe image sources:

The Guardian: http://www.guardian.co.uk/environment/2011/oct/30/africa-poor-west-biofuelbetrayal Action Aid: <u>http://www.actionaid.org/2011/10/how-biofuels-landgrab-has-destroyed-life-african-</u>village



Beginnings of largeholder agricultural development

Protected natural areas in Tanzania:

-45% of land in Tanzania* (*includes nature preserves, national forests, etc)

-~10% National GDP, invaluable to local livelihoods

-Valuable ecosystem services

(e.g. local water and fuel, roles in hydrological or carbon cycles)







Naidoo et al. (2011), J. Applied Ecology



Q: How much land is "protected" in districts with documented large-scale agricultural development?

Legend





Protected areas within agrodevelopment districts

Provinces

Ν

A: A lot, in some places!

More than 10% of district area has been acquired by investors in Rufiji, Bagamoyo districts

In top development districts, 20-50% land area is "protected"

District	District area (ha)	Land acquired	Protected	%Protected	%Acquired	%Other
Mpanda	4.61E+06	1.00E+04	2.85E+06	61.7	0.2	38.1
Monduli	1.61E+06	0.00E+00	9.82E+05	60.9	0.0	39.1
Dodoma Rural	1.48E+06	3.00E+04	7.21E+04	4.9	2.0	93.1
Kilwa	1.38E+06	3.20E+04	3.41E+05	24.6	2.3	73.1
Mbarali	1.36E+06	5.00E+04	6.08E+05	44.8	3.7	51.5
Kigoma Rural	1.36E+06	4.26E+03	5.16E+05	38.1	0.3	61.6
Rufiji	1.34E+06	1.36E+05	6.99E+05	52.3	10.2	37.5
Kilombero	1.31E+06	7.50E+03	9.70E+05	74.0	0.6	25.4
Singida Rural	1.15E+06	0.00E+00	2.36E+03	0.2	0.0	99.8
Bagamoyo	8.61E+05	1.06E+05	1.85E+05	21.5	12.3	66.3
Mvomero	6.28E+05	5.82E+03	8.29E+04	13.2	0.9	85.9
Babati	5.07E+05	0.00E+00	3.43E+05	67.6	0.0	32.4
Kisarawe	4.90E+05	8.21E+03	5.93E+04	12.1	1.7	86.2
Moshi Rural	1.41E+05	4.00E+02	2.26E+04	16.0	0.3	83.7
Arusha	1.09E+04	0.00E+00	2.39E+01	0.2	0.0	99.8

Part II: Where do agricultural development and "protected" areas overlap? Nature of land resources?

Next steps:

-Quantify areas of physical environ. attributes in development districts, natural reserves (e.g. soil texture)

-Incorporate land cover data (when validated)

-Model environmental effects of development of different crops in "acquired" lands



Conclusions and the journey forward...

•Part I: State of current land cover/use and how to map?

-Observable phenology differences between classes, study is ongoing...

-Landsat and Quickbird work to come

•Part II: Some districts with large-scale development have >50% protected area; these are important regions to watch for monitoring/enforcement of protected areas

•Part III: Data on scale of land area acquired, and environmental characteristics a good start for modeling crop production scenarios



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