ENVIRONMENTAL CHANGE AND THE EMERGENCE OF NEW LIVESTOCK PRODUCTION SYSTEMS IN CENTRAL GANSU PROVINCE, CHINA

GREGORY VEECK, CHARLES EMERSON[1], ZHOU LI AND FAWEN YU[2],

[1]DEPARTMENT OF GEOGRAPHY, WESTERN MICHIGAN UNIVERSITY; [2] RURAL DEVELOPMENT INSTITUTE, CHINESE ACADEMY OF SOCIAL SCIENCES

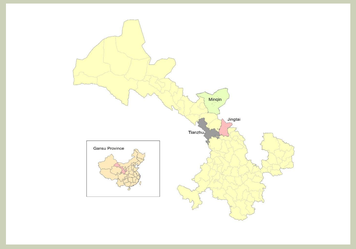
ABSTRACT

Post-2000 efforts to protect China's grassland areas are distinct from earlier efforts in that funding for the most recent round of policies and programs is commensurate with the task. Among the most controversial of the current policies is the provision of an annual subsidy ranging from 2 yuan to 20 yuan/mu (1/15 hectare) to herders to not graze livestock contracted by their families for periods from 3-10 years. Many other recent policies, such as fencing programs and hunting and burning bans to protect keystone species are also controversial. Ideally, the policies are intended to protect grassland ecological systems while assuring acceptable revenues to affected families and regions. In truth, results of these efforts have been mixed, but more successful in locations that tailor policies to local conditions. This poster summarizes a May 2014 study of three counties in Gansu on the interactions among pasture protection policies, outcomes and husbandry. The research joins environmental data and livestock counts at the township scale from 2000 to 2012 to depth interviews with herding families and husbandry officials. Joining biophysical analyses of changes in pasture with in-depth interviews, we seek to determine how the husbandry sector and grassland areas have changed under post-2000 policy interventions. In all three counties included in the study, despite severe degradation, pasture cover has improved and CAFO livestock has increased. However herders and local officials also report that some of the new policies and programs have important unanticipated negative impacts on pasture quality, pasture ecology and economic returns from pasture-based husbandry.

BACKGROUND: CAUSES OF PASTURE DEGRADATION

Many researchers believe that the major anthropogenic reason for the current increase in pasture degradation is overgrazing (Liu , Liu and Zheng 2015, Ma et al. 2014,Wen 2003, Zhao et al. 2005). Indeed, overgrazing probably still stands as contributing factor in many of China's pastoral areas, but there are many other reasons for ecological collapses in pastoral regions that are often far more important at more local scales. In addition to rapid increases in the absolute size of herds using the diminishing grasslands, other scholars cite additional management issues including over-ambitious land reclamation efforts by the agricultural sector (Wen et al. 2015), changing grazing patterns and cycles (Li and Hao 2011), fencing policies that concentrate livestock (Li and Hao 2011,Williams 1996, Williams 1997, Yeh 2005), high stocking rates for goats vis-à-vis other livestock and international fiber prices and market manipulations (Veeck and Emerson 2006), the indiscriminate harvesting of wild medicinal plants (Wen 2003), and illegal mining and the deposition of toxic mine tailings as other significant locally-variable drivers. The changes to China's grasslands are not just anthropogenic in origin. There are also many researchers focusing on the roles that climate change plays with respect to both rising temperatures and declining precipitation on China's grassland areas (Chen et al. 2006, Liu, Dong, and Liu 2015,Waldron, Brown and Longworth 2010, Wei et al. 2009, Wen et al 2015).

LOCATION OF THE RESEARCH IN WESTERN CHINA: GANSU



In May of 2014 visits were made to three counties in Gansu (Jingtai, Minqin, and Tianzhu A.C.) to investigate the interactions among pasture protection policies, economic outcomes for herding families and the husbandry sector. The research joins remotely-sensed environmental data and livestock counts at the township scale for the years from 2000-2012 to depth interviews with herding families and village, township and county officials who work on issues some way related to the husbandry sector.

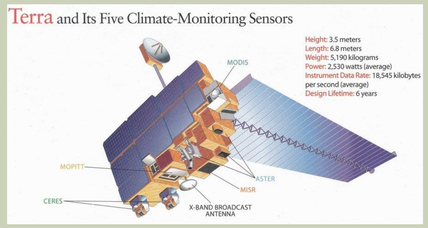
METHODOLOGY

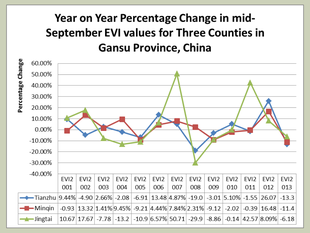
Spatial coverage of the Enhanced Vegetation Indices (EVI) Monthly L3 Global 1 km2 (pixel) data product (MOD13A3) was obtained for 57 township (sub-county) through the online Data Pool at the NASA Land Processes Distributed Active Archive Center (LP DAAC), USGS/Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota (https://lpdaac.usgs. gov/data_access) for the fourteen years from 2000 to 2013. Map algebra allowed for the calculation of zonal mean EVI scores for all pasture areas aggregated to the township boundaries for the three counties selected for the study. Areas in each county not identified as pasture areas—urban, forest, etc. – based on a 2000 grassland area map provided by the Chinese Academy of Sciences-- were excluded from the analyses. The MODIS EVI product used is a 30-day cloud-free composite for mid-September.

Once counties were selected and permission to survey in the county was obtained from the authorities, the township boundaries were digitized from township-scale maps collected during each visit and used to calculate mean mid-September EVI within pasture areas in all of the townships. Once calculated, the township-scale EVI values can be compared to changes in livestock density (standardized animal units per hectare –AU/Ha) to provide independent assessments of changes in pasture density (not quality) over time ADJUSTED FOR PRECIPITATION.

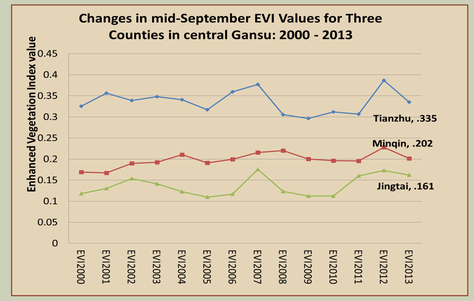
Once precipitation-adjusted EVI was created via OLS regression, these estimates of "green-ness" are compared with livestock density/hectare to determine if EVI is statistically associated with livestock density per hectare.

RESULTS FROM MODIS IMAGERY ANALYSIS





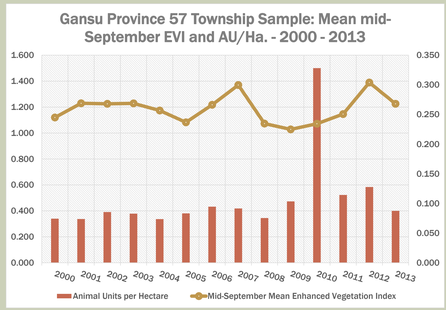
	EVI2 001	EVI2 002	EVI2 003	EVI2 004	EVI2 005	EVI2 006	EVI2 007	EVI2 008	EVI2 009	EVI2 010	EVI2 011	EVI2 012	EVI2 013
Tianzhu	9.44%	-8.90	2.66%	-2.08	-6.91	13.48	4.87%	-19.0	-3.01	5.10%	-1.55	26.07	-13.3
Minqin	-0.93	13.32	1.41%	9.45%	-9.21	4.44%	7.84%	2.31%	-9.12	-2.02	-0.39	16.48	-11.4
Jingtai	10.67	17.67	-7.78	-13.2	-10.9	6.57%	50.71	-29.9	-8.86	-0.14	42.57	8.09%	-6.18



Annual EVI	Mean	Std. Deviation
EVI2000	0.213	0.105
EVI2001	0.227	0.116
EVI2002	0.235	0.097
EVI2003	0.236	0.104
EVI2004	0.235	0.110
EVI2005	0.216	0.105
EVI2006	0.237	0.120
EVI2007	0.265	0.115
EVI2008	0.226	0.102
EVI2009	0.213	0.102
EVI2010	0.217	0.109
EVI2011	0.227	0.089
EVI2012	0.272	0.108
EVI2013	0.240	0.100

Analyses of mean enhanced vegetation index (EVI) aggregated to 57 township units in three counties of central Gansu indicated IMPROVED pasture quality for the period from 2000 to 2013 DESPITE very significant increases in livestock in a majority of townships for all three counties (see next column top). Field trips throughout May of 2014 were made to interview herders and local government officials responsible for pasture management and husbandry extension

INCREASES IN LIVESTOCK WHILE EVI IMPROVED



REASONS FOR PASTURE IMPROVEMENTS

1. Loan programs initiated—and managed locally-to provide capital and credit for livestock sheds (CAFOs), fodder systems and other infrastructure.
2. Many pasture areas were placed in restricted access programs via herding bans **AND FORCED or Voluntary HERDER resettlement**—accompanied with annual subsidies 2-20 yuan */mu. ($(5.00 – 50.00/Ha)/year AND New Home Construction (NOT Popular with herders!)*
3. Promote irrigated alfalfa, corn/sorghum silage production
4. Increased extension support for breeding stock and improved veterinary consultations and vaccinations.

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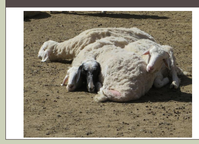

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