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Land-Use and Land-Cover Change in Sonora, Mexico: Trajectories of Agricultural Intensification and Consequences for Non-Agricultural Ecosystems

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The objective of our research is to evaluate the causes and consequences of agricultural development in the Yaqui Valley of northwestern Mexico. The Yaqui Valley is the home of the Green Revolution for wheat, and one of the most productive breadbaskets of Mexico. Until the first half of this century, it was primarily a desert scrub ecosystem; development of irrigation and fertilization systems has lead to dramatic changes in the Valley, and potentially in surrounding regions as well. We are analyzing the critical links among agricultural policy and agricultural extent and productivity within the Valley, as they have changed over the last fifty years and continue to change. Moreover, we will utilize remote sensing data to evaluate the off-site consequences of these agricultural land-use decisions for land-use and land-cover in the surrounding region, focusing on 1) the extensive changes in land use in the areas surrounding the agricultural valley (e.g., expansion of grazing systems in the scrub desert ecosystems at the edge of the Yaqui Valley); and 2) alteration of native ecosystems as a result of down-wind deposition of anthropogenic nitrogen from the Valley.

We are collating data bases of three types, and most of our effort since the initiation of this project has been directed to this part of the project: 1) historical data from the Yaqui Valley Irrigation District; 2) farm-level socio-economic and agronomic surveys conducted by CIMMYT and by Naylor during the past 15 years; and 3) MSS, TM, and AVHRR data registered in an ARC/INFO based GIS, along with climate, soils, and topographic data bases, for the Valley and surrounding regions. To facilitate this data collection, we have hired a Meixcan national, Luz Marie Cisneros, to carry on on-site data collections; she is working closely with our personnel at Berkeley and Stanford.

Spatially Referenced Data

As part of these database activities we have acquired the following spatially referenced data layers:

1. a FAO soils map of Mexico

All of the following cover the Yaqui Valley
(**from CIANO**)
2. soil texture
3. soil type
4. salinity
5. depth to water table
6. the block system of land divisions

(**from CIESIN**)
a point coverage of 30,000+ Mexican localities with the following attributes:
7. population in 1990
8. population by gender

9. literate/illiterate population 6 to 14 years
10. literate/illiterate population 15 years and older
11. polygon coverage of the Mexican

a polygon coverage of 2,000+ Mexican municipalities with the following attributes:
12. population in 1990
13. population per square kilometer
14. population by gender
15. population in 3 age classes- <6, 6-14, >15
16. literate/illiterate population 6 to 14 years
17. literate/illiterate population 15 years and older

The municipalities of interest are: Heroica Guaymas, Bacum, Cuidad Obregon, Etchojoa, and Navojoa

a point coverage of urban places with the following attributes:
18. locality and urban place name
19. population in 1921
20. population in 1930
21. population in 1940
22. population in 1950
23. population in 1960
24. population in 1970
25. population in 1980
26. population in 1990

The urban places of interest are: Cocorit, Esperanza, Cuidad Obregon, Pueblo Yaqui, Villa Juarex, and Bacobampo

We are in the process of converting all of these data layers into Arc/Info format with a common map projection (UTM coordinates).

Non-Spatially Referenced Data Sets

We have also been collecting non-spatially referenced data for our database. These include the following datasets:
(D= diskette, P= paper)

CROP AREAS AND YIELDS
Data by ownership "ejidal"(ejidos) and "particular" (privately owned).
Planted area, Harvested area, Production, Yield/ha, mean price, and total value of the production. Data by crop and season.

SOURCE:
CNA and SAGAR

CYCLE	PERIOD OF THE YEAR			WHOLE YEAR
	SUMMER	WINTER	SPRING	
73/74	P			
74/75	P			
75/76	P			
76/77	P			
77/78		P	P	
78/79	P	P	P	
79/80		P	P	[1]P

80/81	P	P	P	[1]P
81/82	P	P	P	[1]P
82/83	P	P	P	[1]P
83/84	P	P	P	[1]P
84/85	P	P	P	[1]P
85/86	P	P	P	P
86/87	P	[4]P	[4]P	[4]P
87/88	P	[4]P	P	P
88/89	P	P	P	P
89/90	P	P	P	[2]P
90/91	[1]P	P	[1]P	[1]P
91/92	[1]P	P, D	[1]P, D	[1]P
92/93	[1,3]P	[1,3]P	[1,3]P	[1]P
93/94	[1]P, D	[1]P, D	[1]P, D	[1]P
94/95	[1]P, D	[1]P, D	[1]P, D	[1]P
95/96	[1]P, D	[1]P, D	[1]P, D	[1]P
96/97	D	D		[1]P, D

[1]Data by ownership is not available.
[2]For cycles 89/90 through 96/97, the source for data on paper is SAGAR.
[3]Available by season on the whole year folder only.
[4]Data available for Yaqui Colonies also. (No data available for ownership.)

PRODUCTION

SOURCE:
CNA

Data by crop.

TYPE OF INFORMATION:	CYCLES		DATA AVAILABLE ON
	From	To	
Production	1969/70	1994/95	D
Yield	1969/70	1994/95	D
Harvested area	1969/70	1994/95	D
Irrigated area (for initial permit)	1969/70	1994/95	D
Mean prices (pesos/ton)	1969/70	1994/95	D
Total Value for the production	1969/70	1994/95	D
Planted area[4]	1974/75	1994/95	D

PRODUCTION (1955-1978)
Harvested area, Production Yield/ha, Total value for the production (pesos). Data by crop and cycle (only main crops.) Paper covers Yaqui Valley, Valle del Mayo, Valle de Guaymas, Costa del Hermosillo, Region Caborca, San Luis Rio Colorado, Yaqui Colonies. Digital version has Yaqui Valley only.

SOURCE:
SAGAR

CROP	CYCLE		AVAILABILITY
	From	To	
Trigo	1955/56	1977/78	P, D
Maiz	1959	1978	P, D
Algodon	1958	1978	P, D
Soya	1960	1978	P, D
Cartamo	1959	1978	P, D
Arroz	1959	1959 only	P, D
Sorgo	1959	1978	P, D
Cebada	1958	1965	P, D
Linaza	1958	1978	P, D
Alfalfa	1958	1976	P, D
Frijol	1959	1977	P, D
Ajonjoli	1959	1978	P, D
Garbanzo	1968	1976	P, D
Hortalizas	1976	1977	P, D

WATER USE
Volume of water delivered to users and volume used, including extraction from the reservoir. Data by month.

SOURCE:
CNA

CYCLE	DATA AVAILABLE ON
76/77	P, D
77/78	P, D
78/79	P, D

GROSS WATER USE
Gross Volume registered in the report of Water Distribution.

SOURCE:
SAGAR

CYCLE		DATA AVAILABLE ON
From	To	
1987/88	1993/94	D

We are in the process of translating these data to English and entering the files into an excel database. These data are will be spatially referenced when possible and merged as info files in our GIS database.

We also obtained precipitation and temperature data for the region spanning from 1959 to the present. We have analyzed this data for seasonal trends and averages and will use this information in selecting remote sensing imagery for the region.