Agricultural Cost of Maintaining Playa Lake Hydroperiod to Preserve Playa Lake Ecosystems in the Texas High Plains

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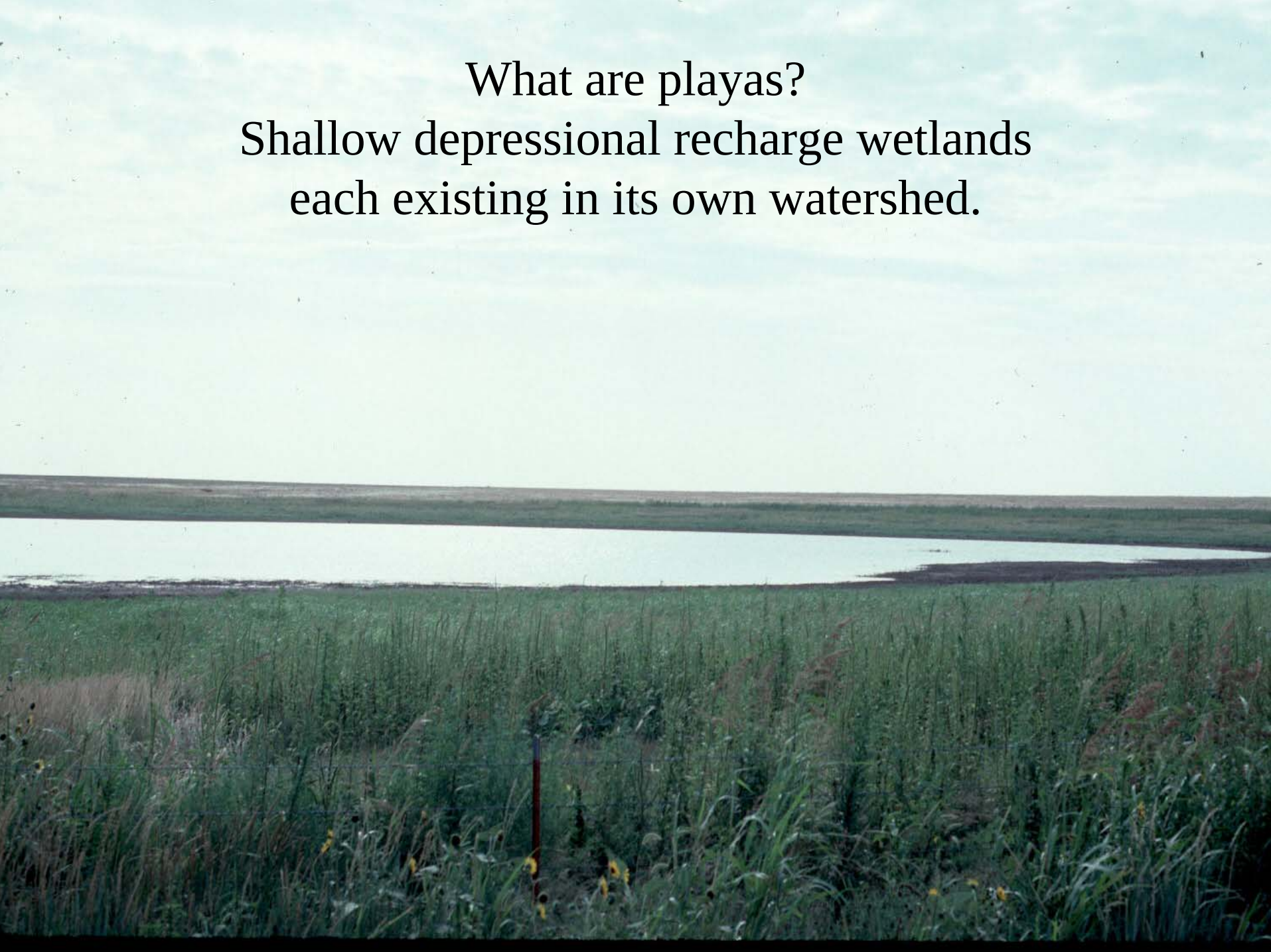
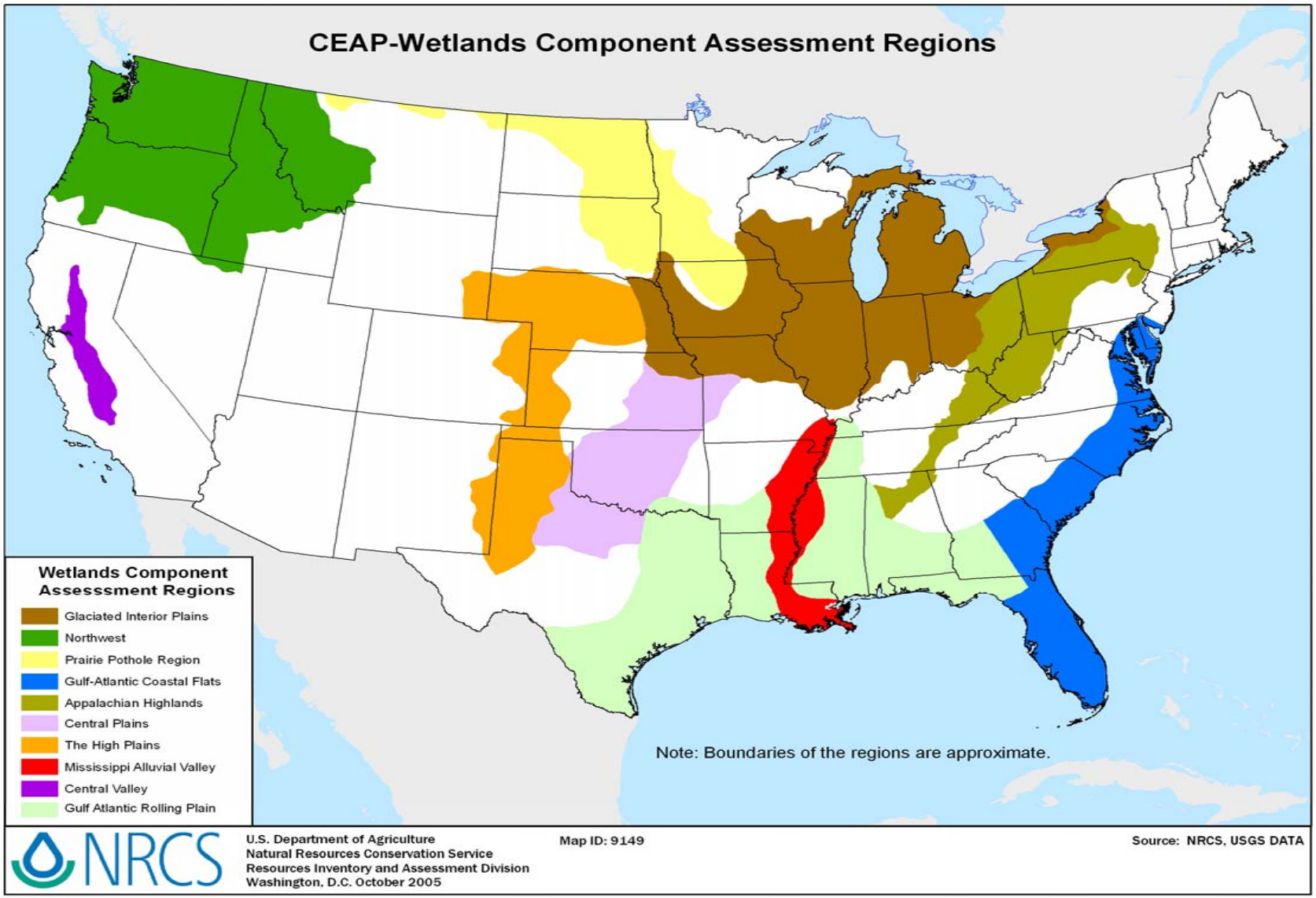
What are playas?
Shallow depressional recharge wetlands
each existing in its own watershed.



CEAP-Wetlands
Regional Assessment Locations



Summary Playa Information

Average Playa Area is 6.3-ha (15.5 acres) and 87% of all Playas are less than 12-ha in Southern Great Plains.

In Texas 98% of all Playas are located on Private property.

90% of the 25,000 Playas in the Southern Great Plains have been destroyed.

ROLES OF PLAYAS IN THE SOUTHERN HIGH PLAINS

(1) Natural Flood Control

(2) Wildlife Habitat

(3) Conservation of Native Plants

(4) Aquifer Recharge

(5) Recreation and Aesthetic

WHAT MAKES A PLAYA A PLAYA?

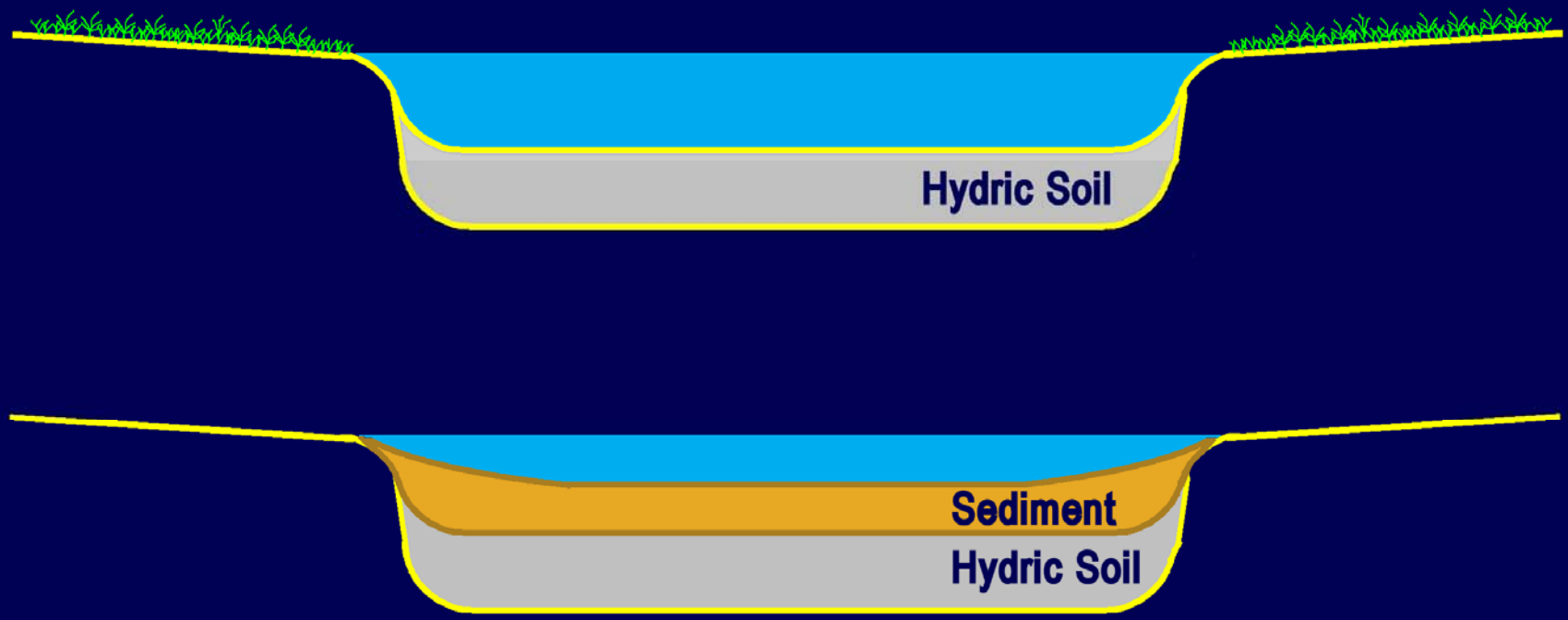
Just because a playa depression exists and water collects does not mean that the playa remains!

Agricultural land use practices have decreased playa hydro-period and biological diversity

Agricultural Conversion of a Playa

A Non-Functioning Playa

Agricultural Land Use Practices Cause Playas to Fill with Sediment



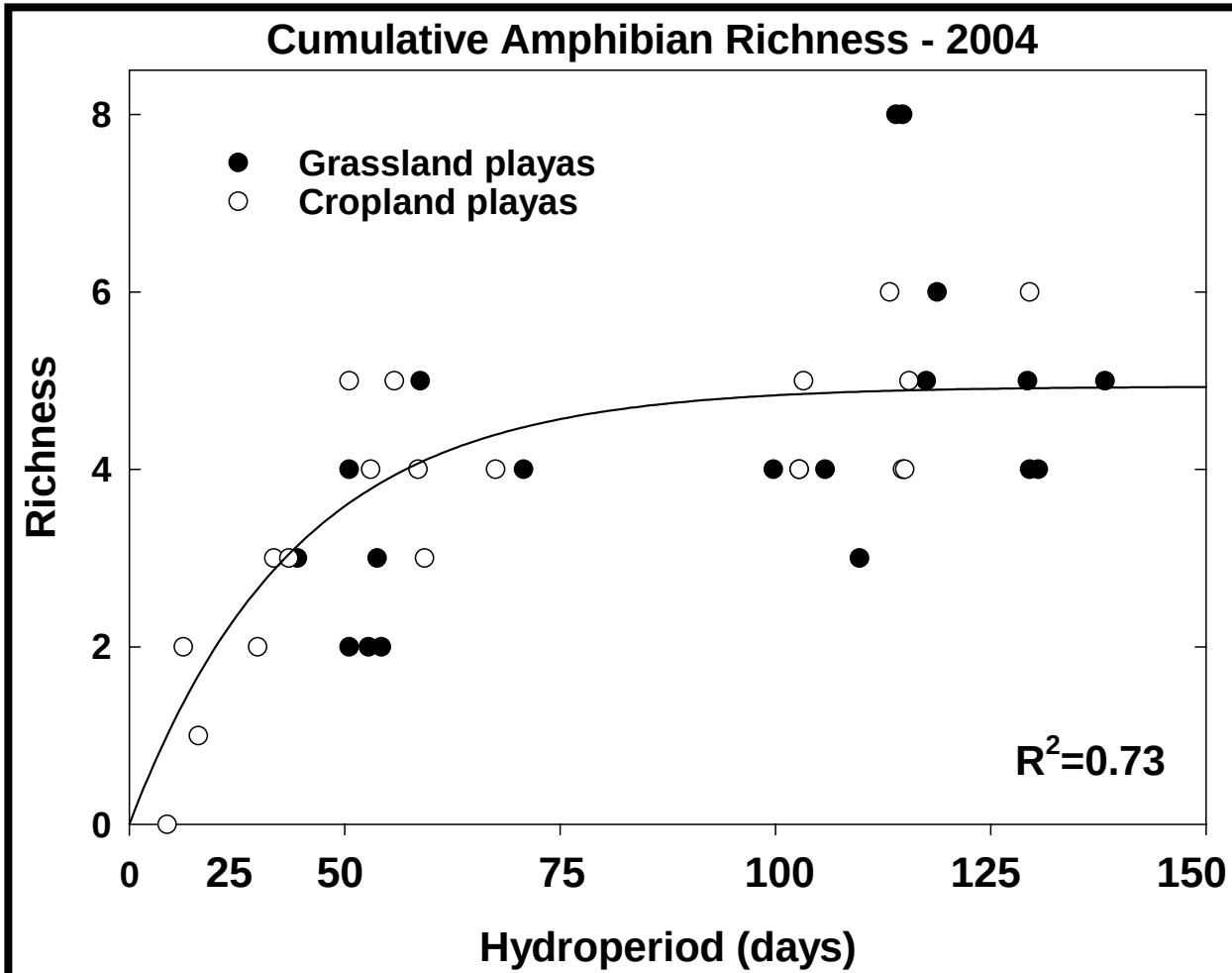
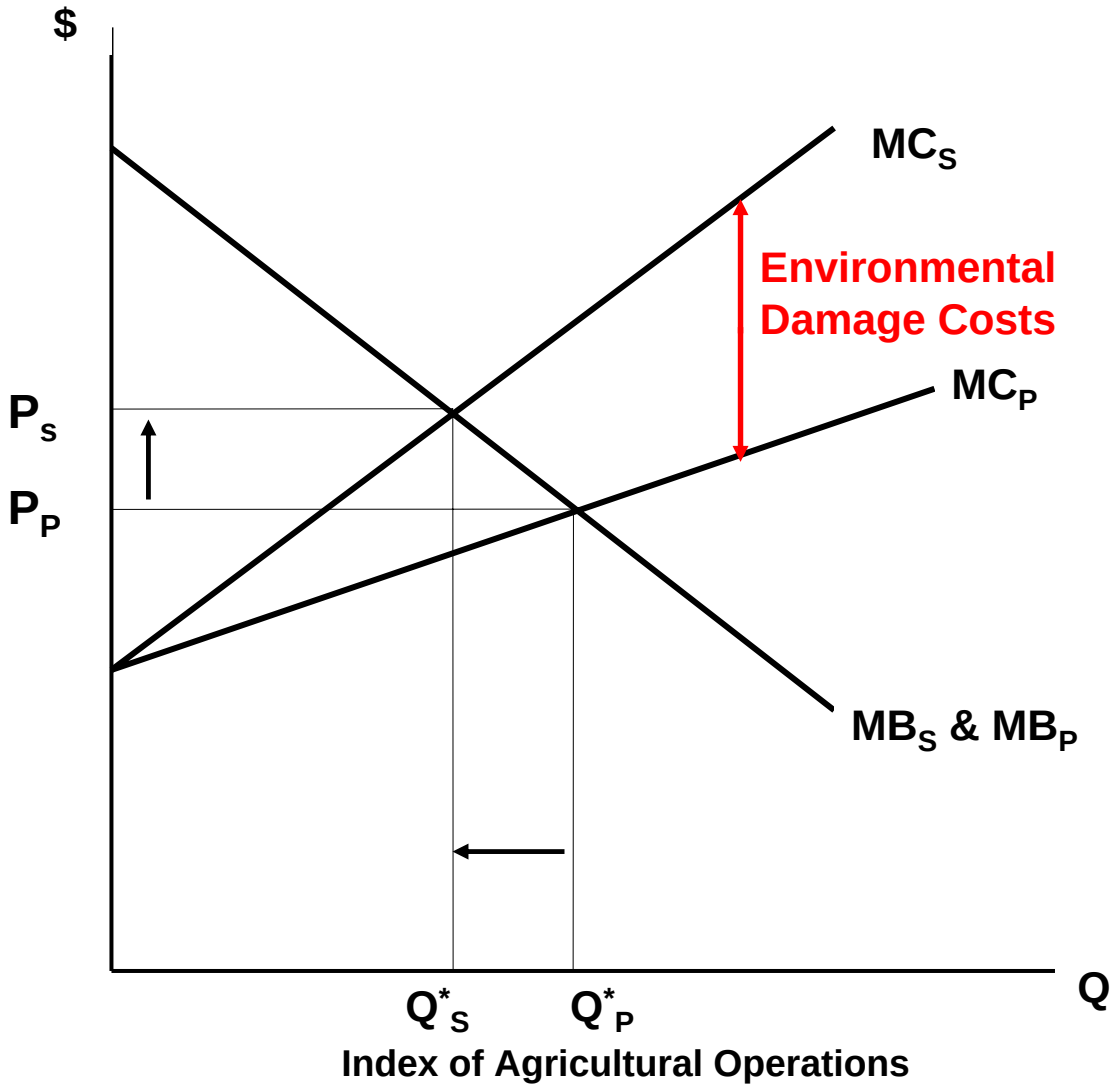
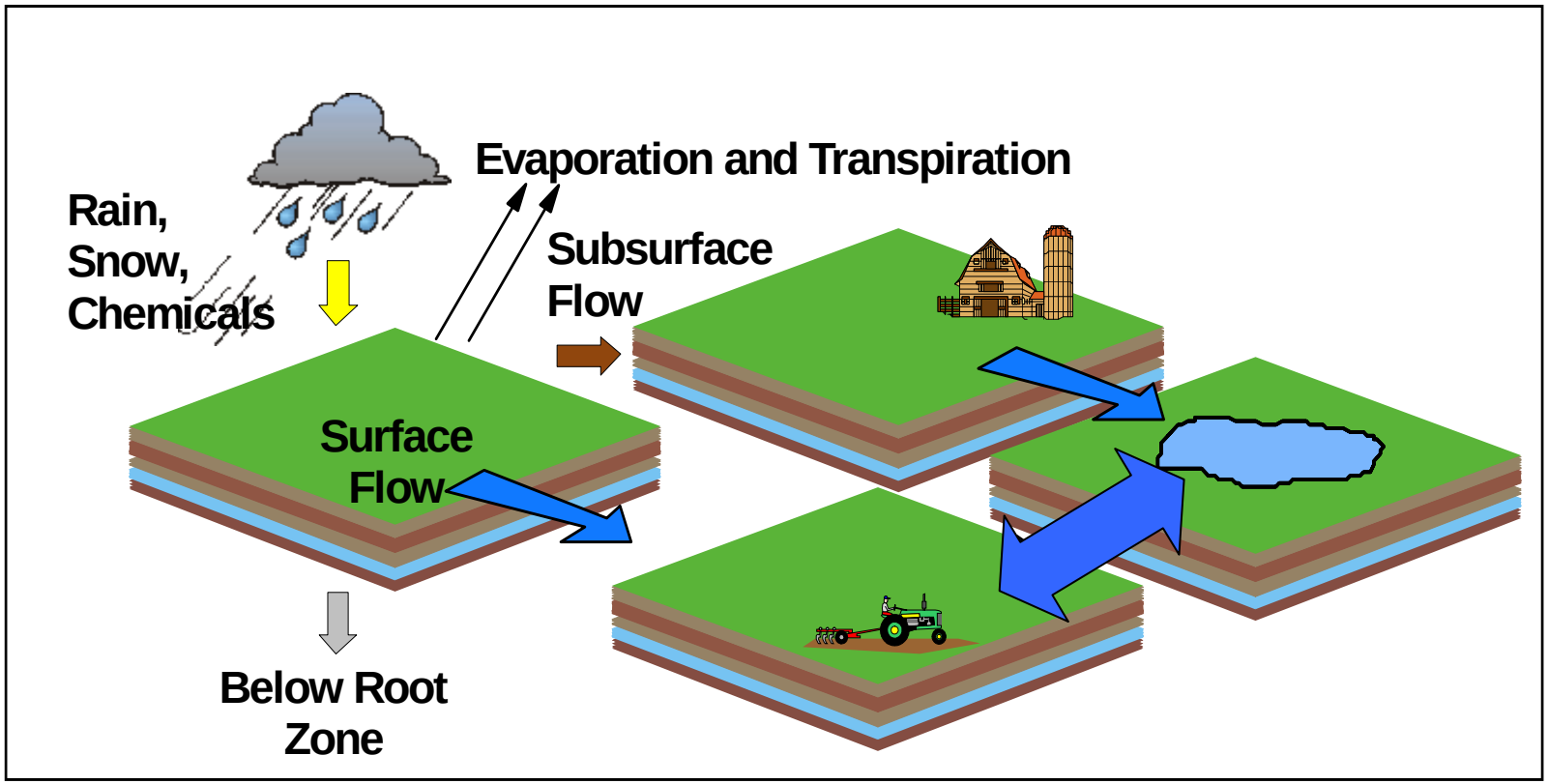


Fig. 6. Total number of amphibian species observed in grassland and cropland playas in the Southern High Plains in 2004.

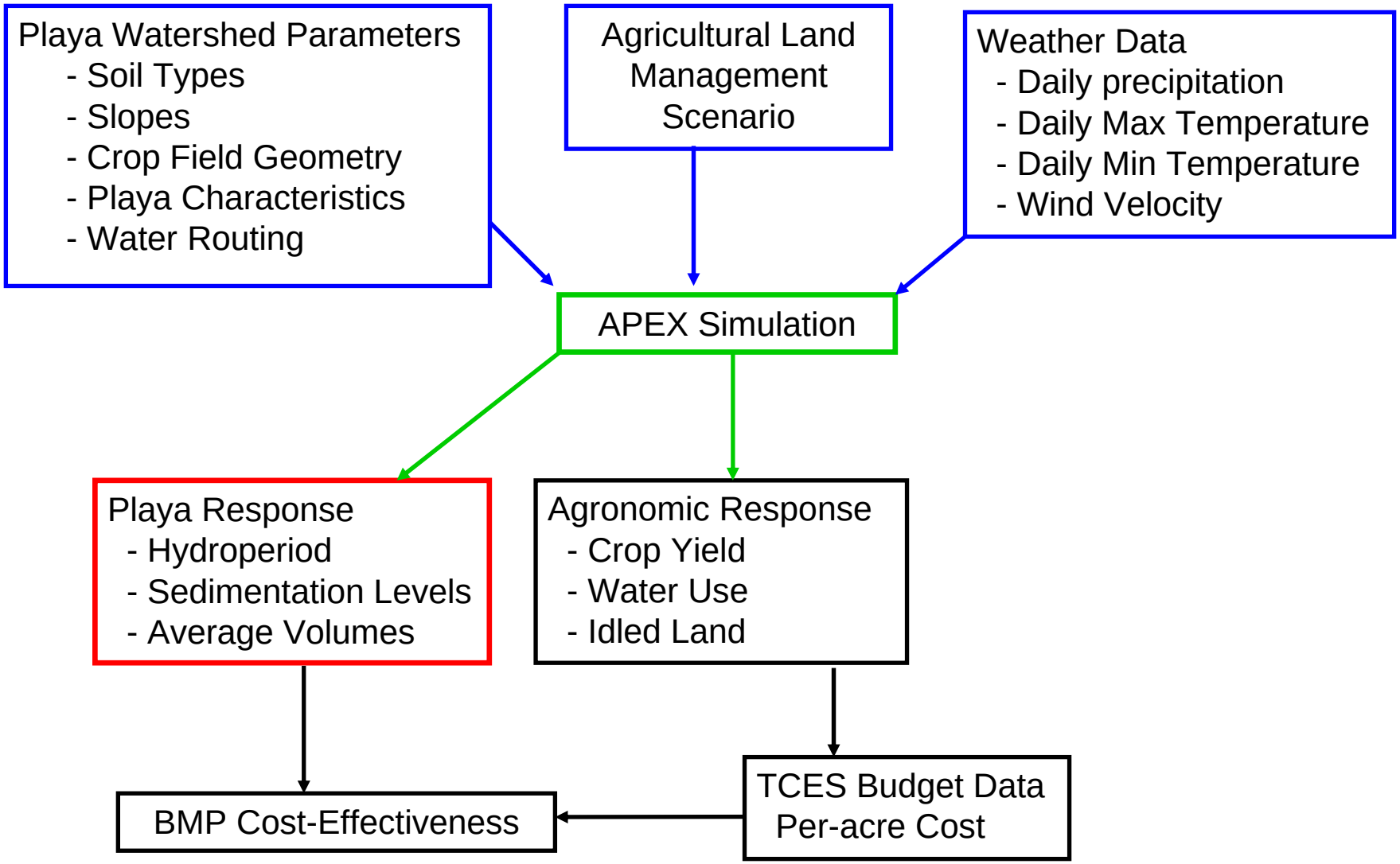
Playa Loss is a Classic Externality



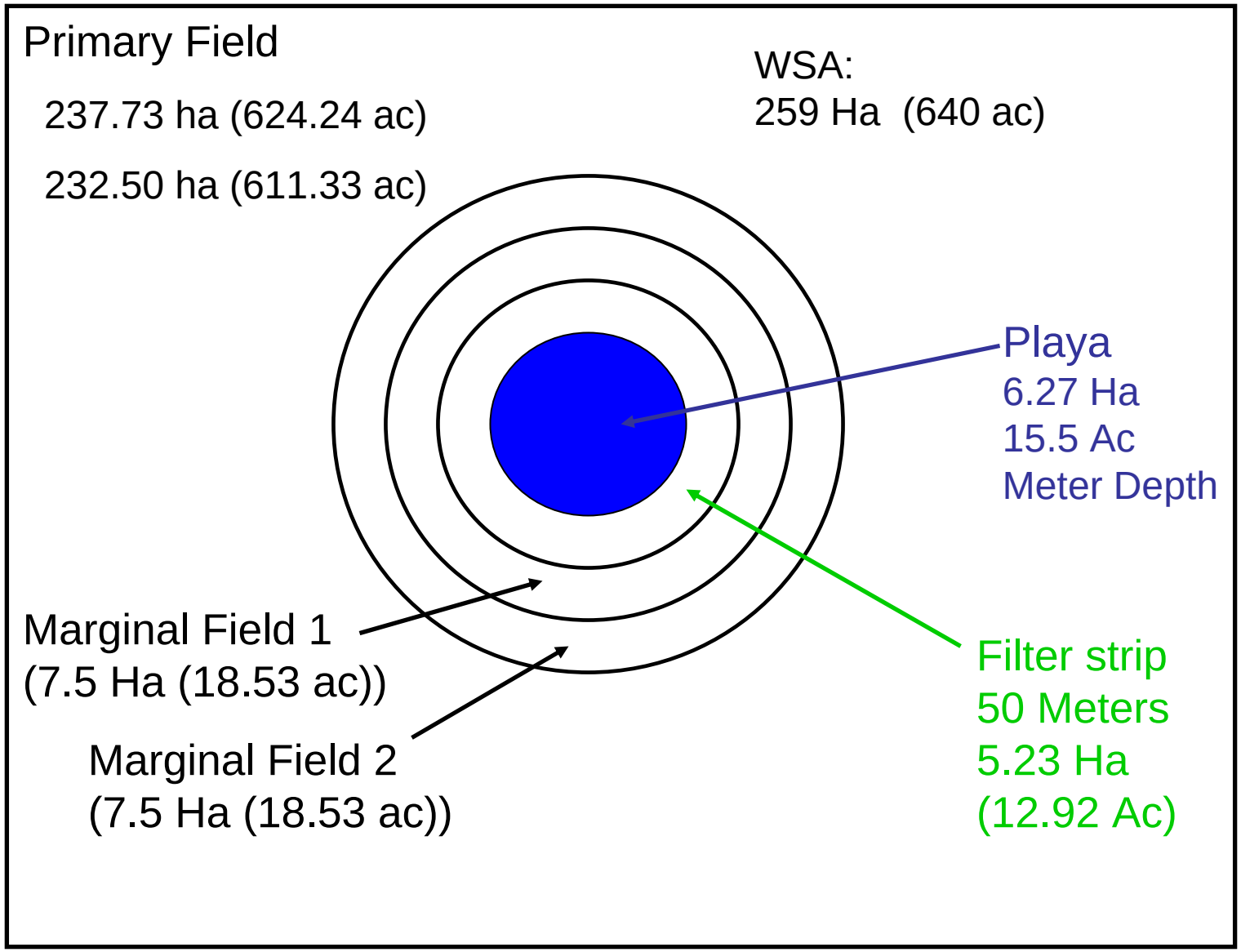
Agricultural Policy-Environmental eXtenter Model (APEX)



Flow Chart of Physical, Biologic, and Economic Data Used in Management Practice Cost-Effectiveness Analysis



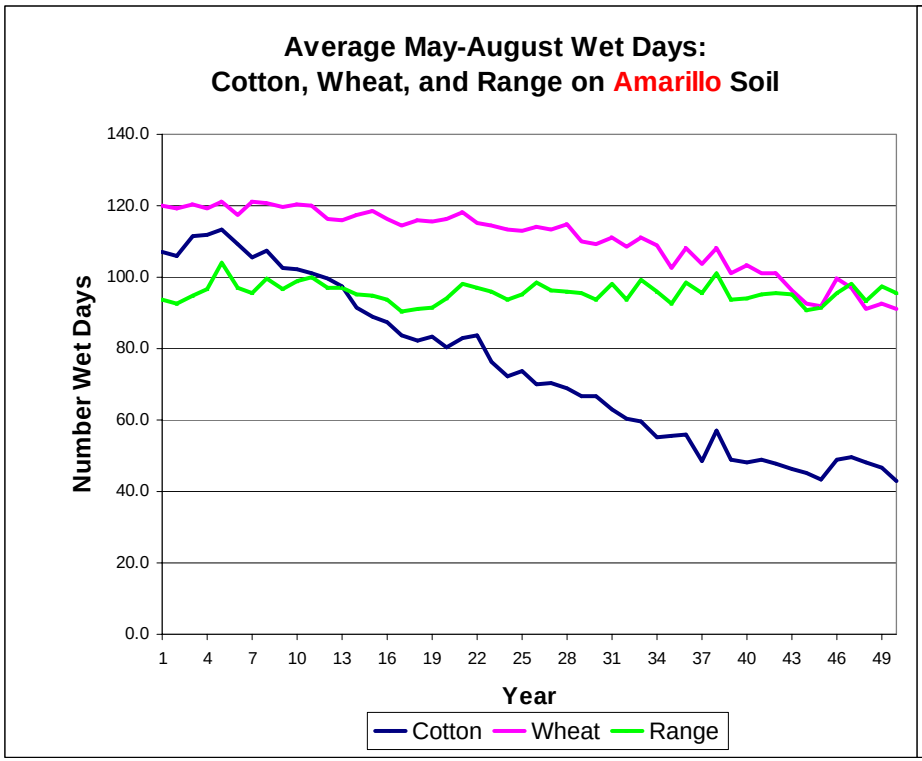
Illustrative Playa Watershed Design

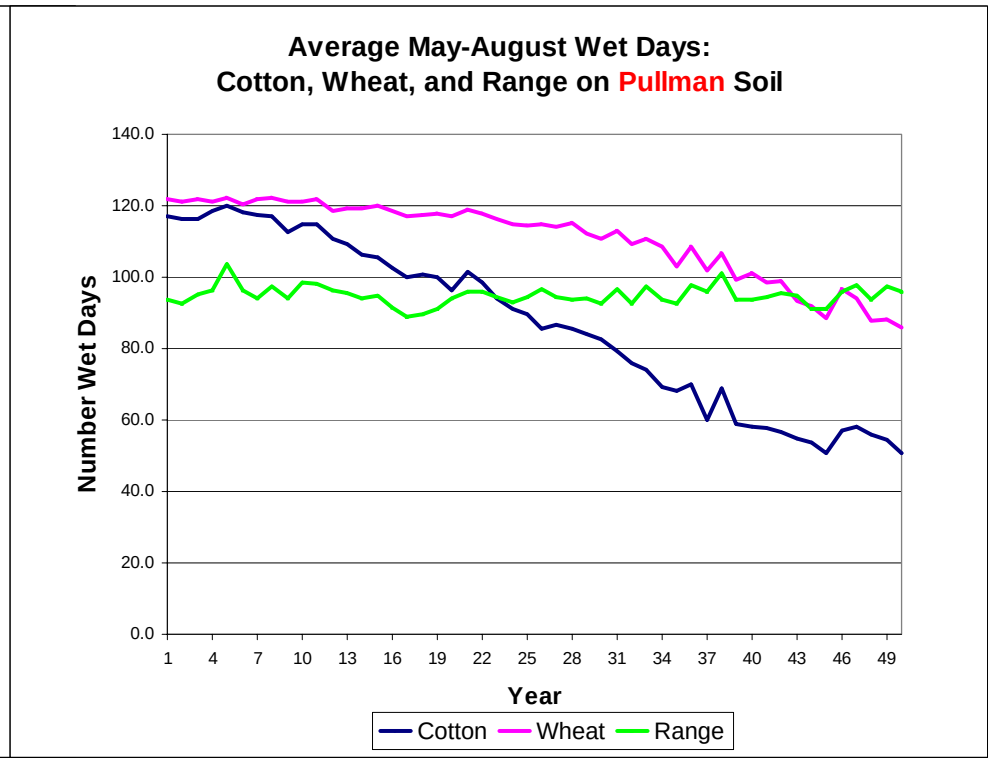


Average Yearly Playa Wet Days: May 1 – August 31

100 50-year Simulations

Average Yearly Playa Wet Days: May 1 – August 31



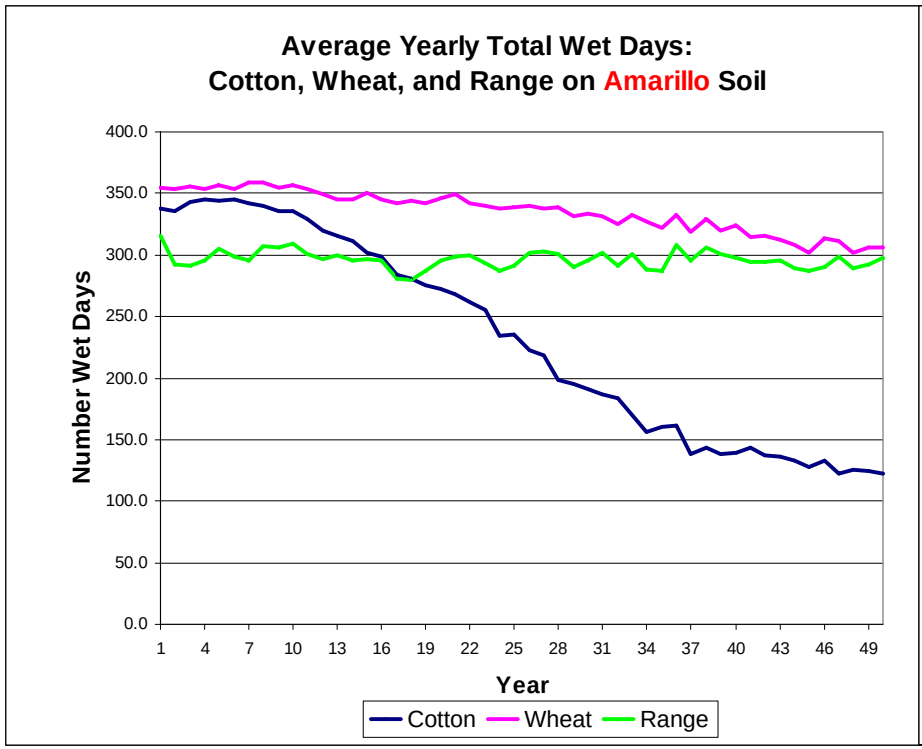


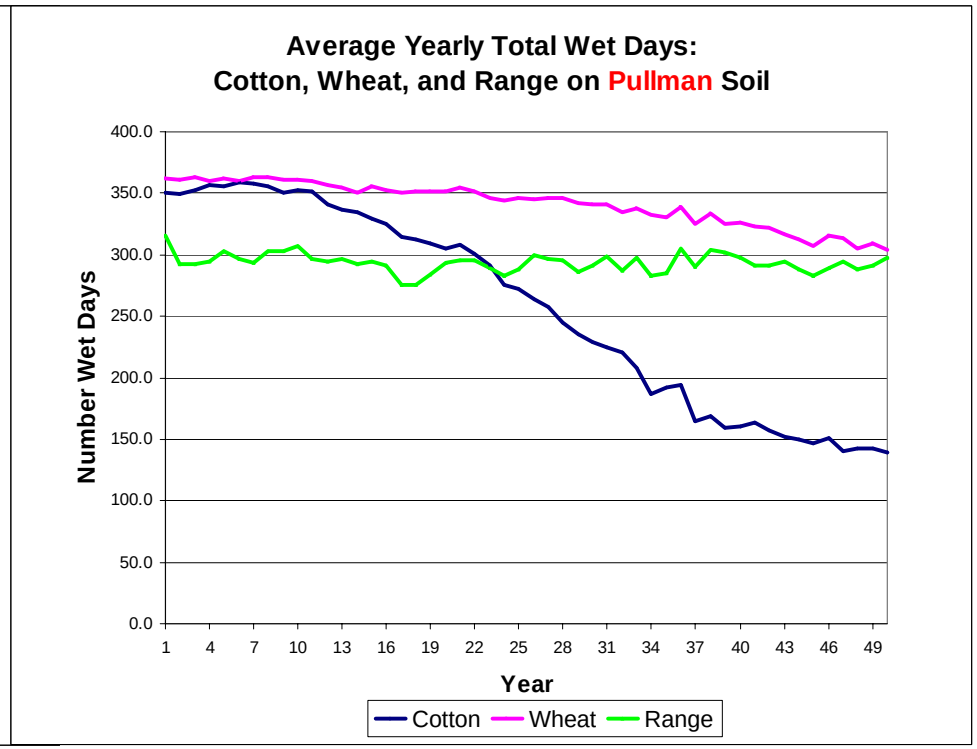
Average Yearly Playa Wet Days

***Less Variable* than May1-August 31**

100 50-year Simulations

Number Average Yearly Playa Wet Days *Less Variable* than May1-August 31



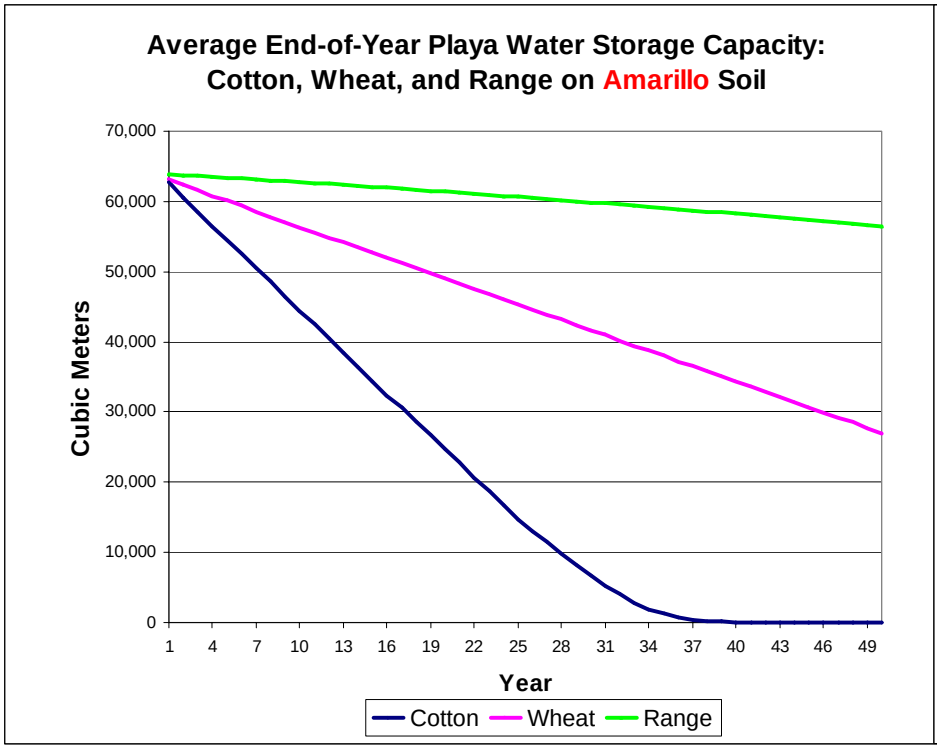


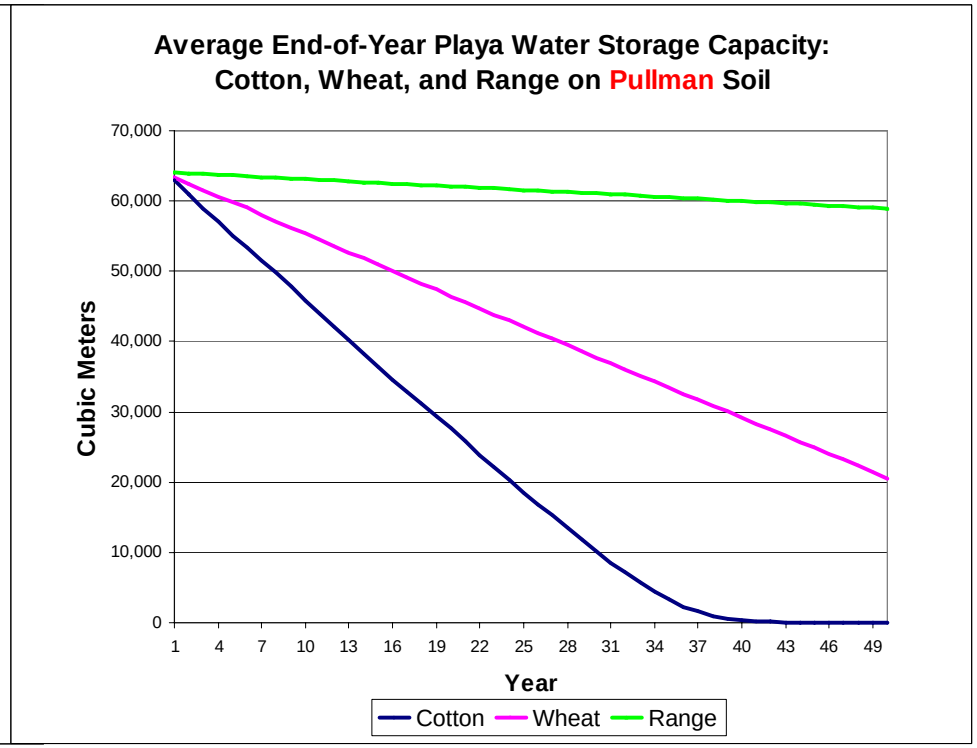
Why are Wet Days Lost?

Average End-of-Year Playa Storage Capacity

100 50-year Simulations

Average End-of-Year Playa Storage Capacity

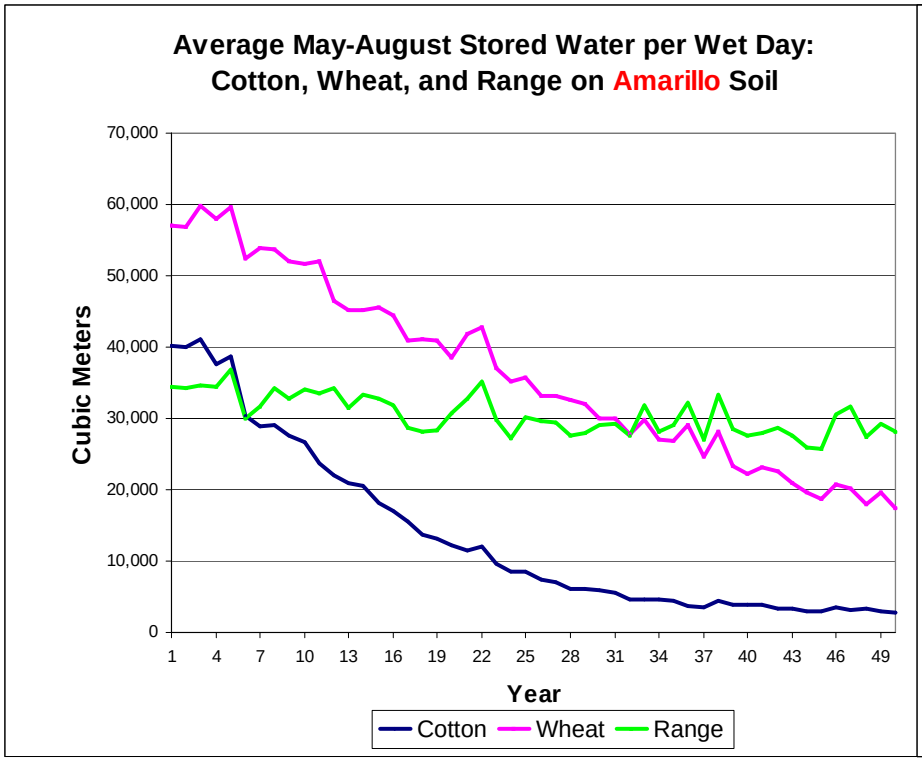


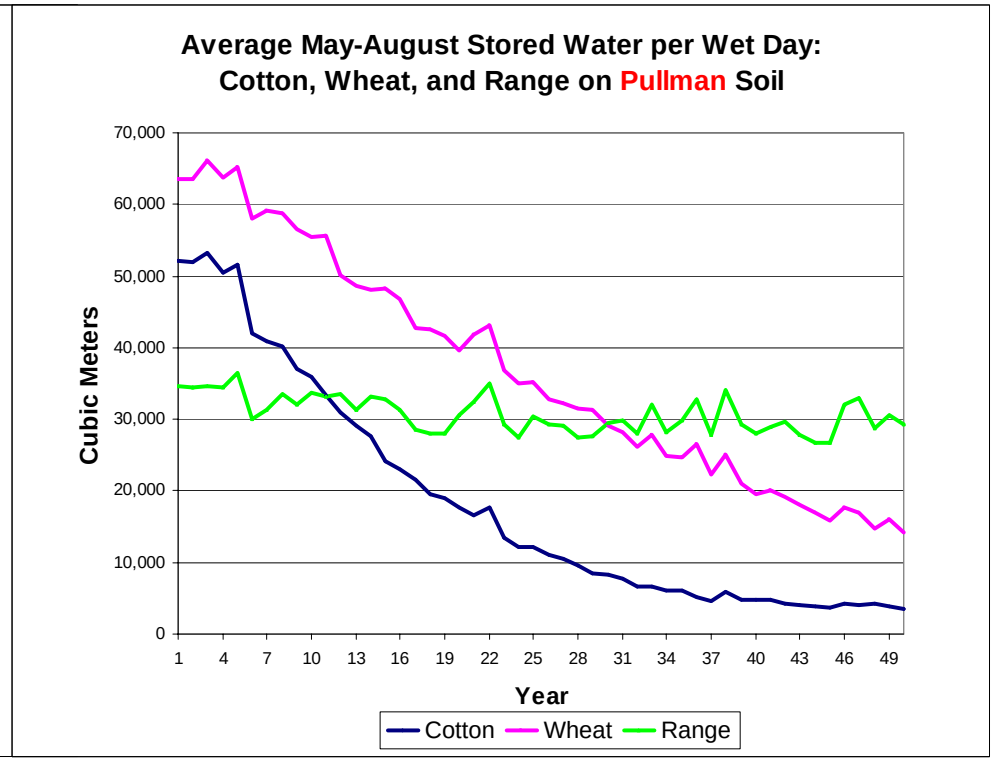


Average Yearly Playa Stored Water Volume per Wet Day: May 1 – August 31

100 50-year Simulations

Average Yearly Playa Stored Water Volume per Wet Day: May 1 – August 31

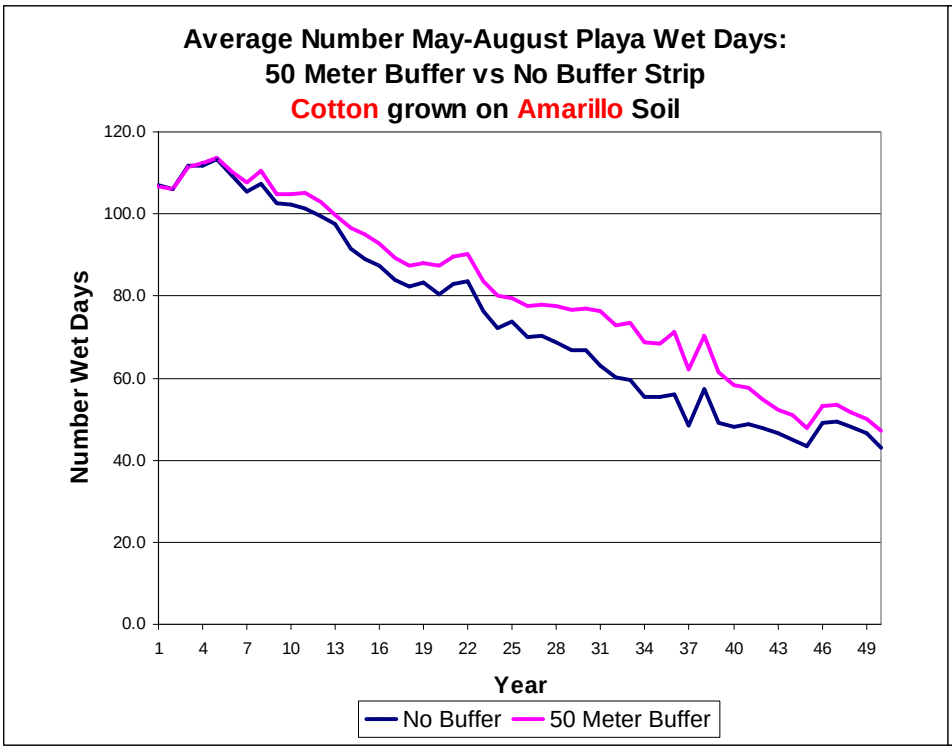


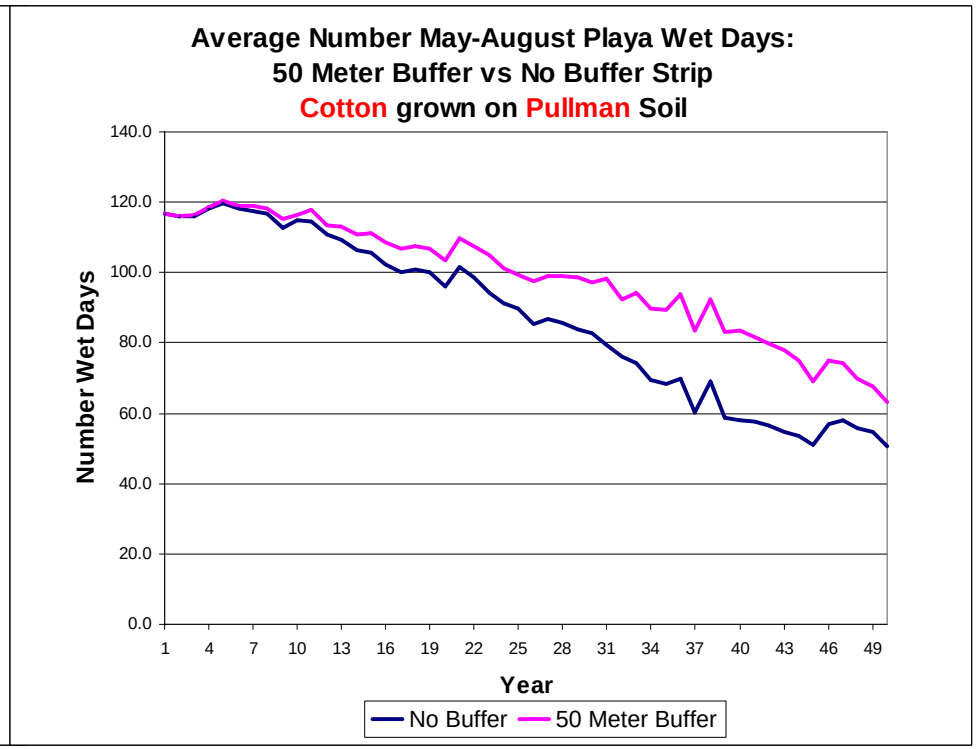


Controlling Agricultural Impacts

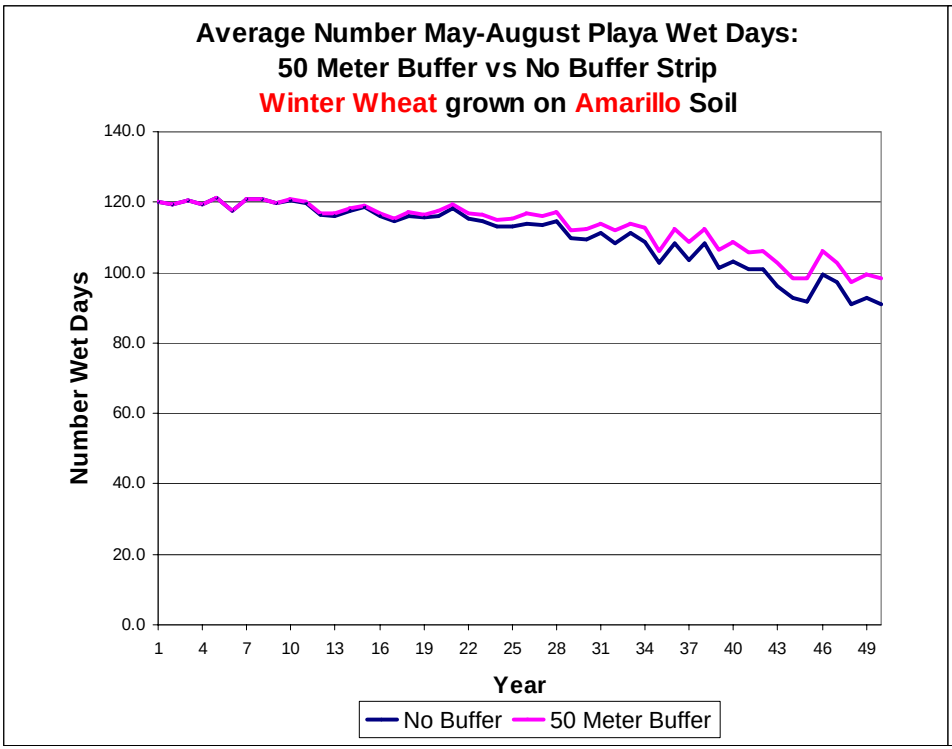
Buffer Filter Strip Effectiveness in protecting Number of Playa Wet Days between May 1–August 31:

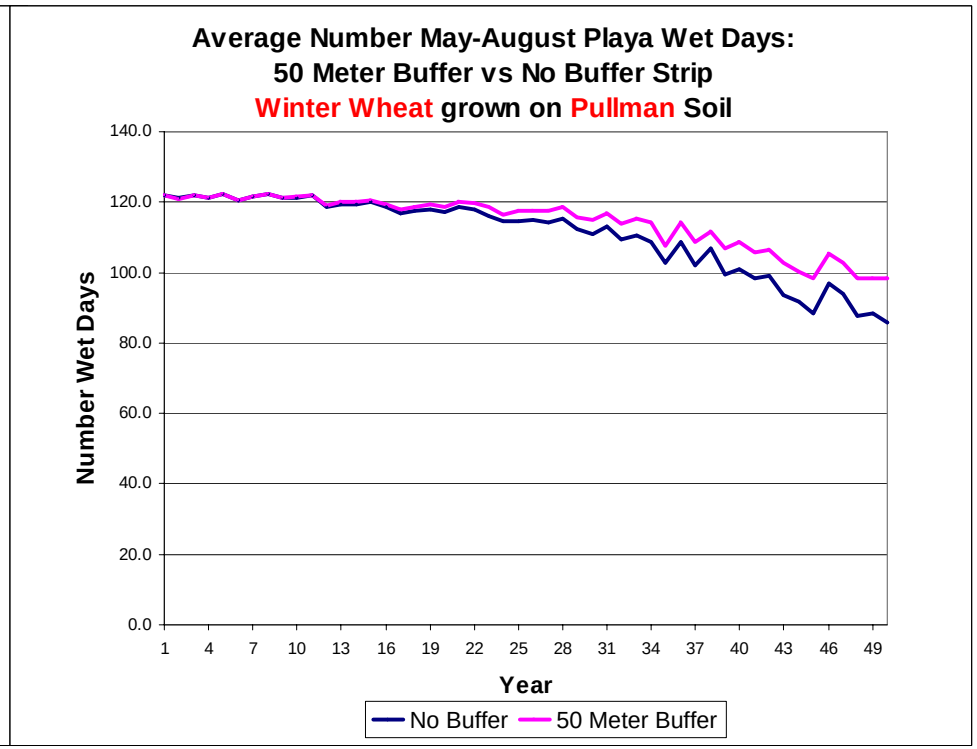
Buffer Filter Strip Effectiveness
Number of Playa Wet Days: Cotton





Buffer Filter Strip Effectiveness
Number of Playa Wet Days: Wheat

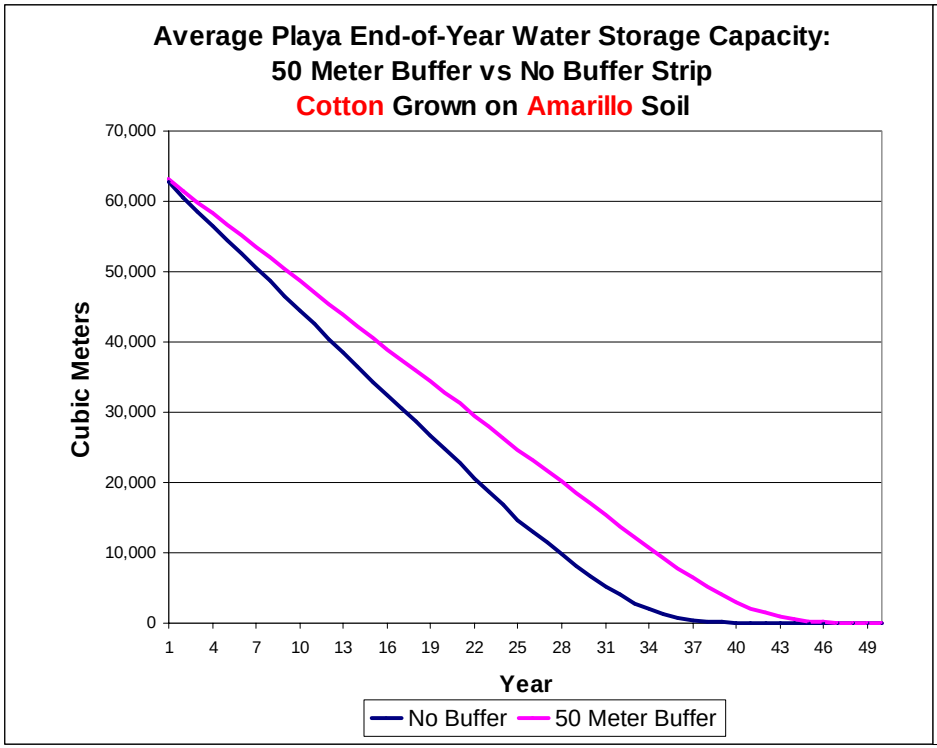


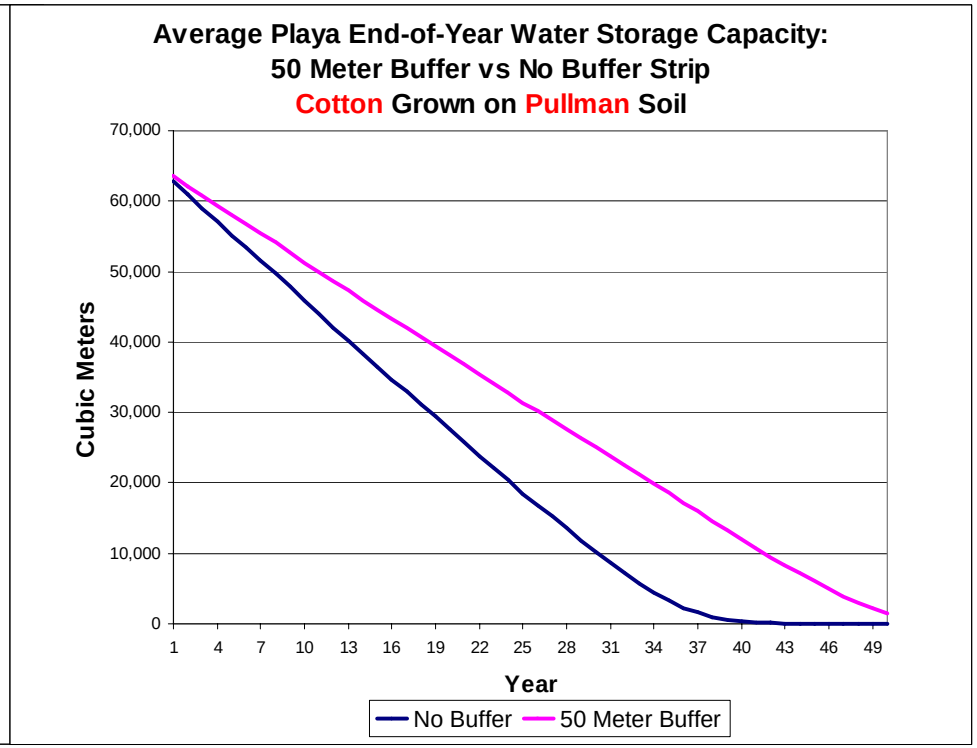


Controlling Agricultural Impacts

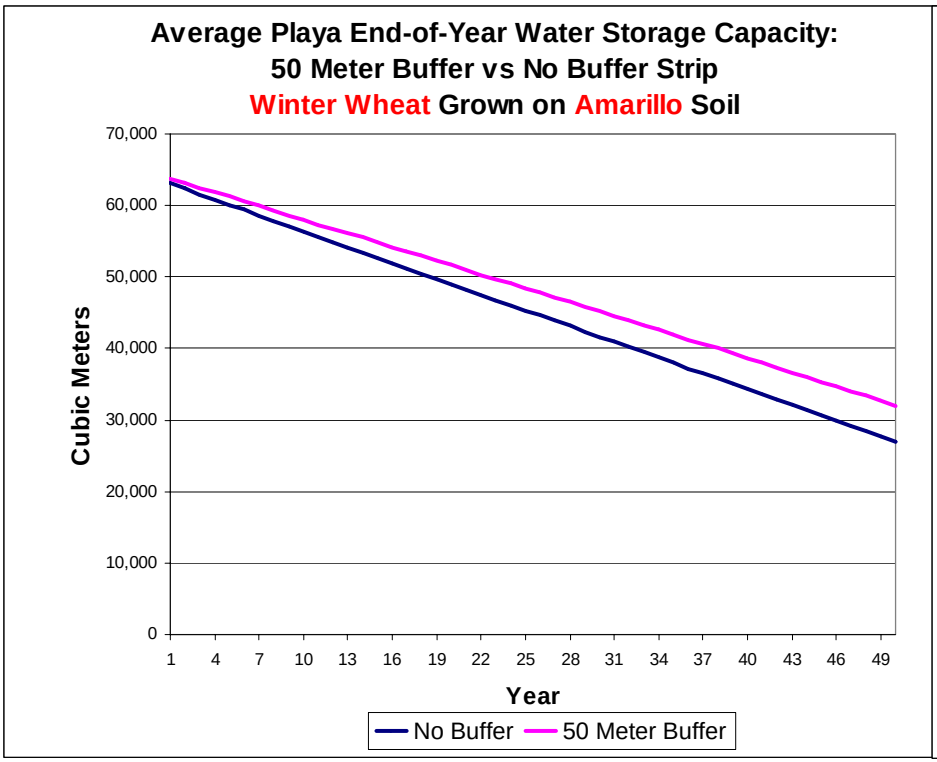
Effectiveness of Buffer Filter Strips in protecting Initial Playa Water Storage Capacity:

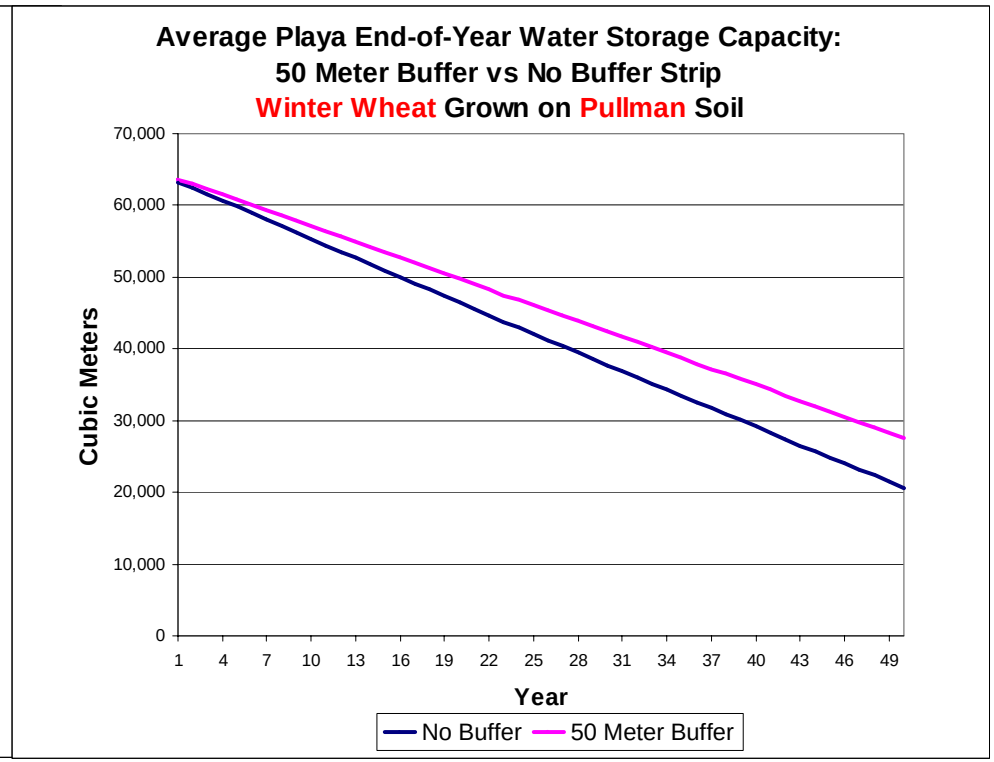
Buffer Filter Strip Effectiveness
End-of-Year Storage Capacity: Cotton





Buffer Filter Strip Effectiveness
End-of-Year Storage Capacity: Wheat

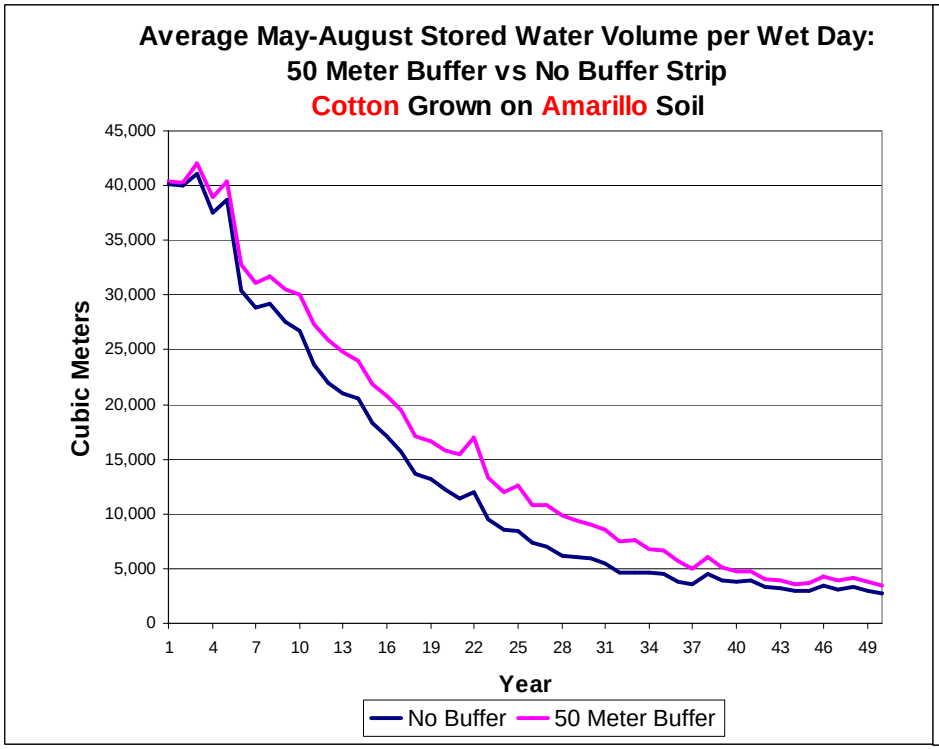


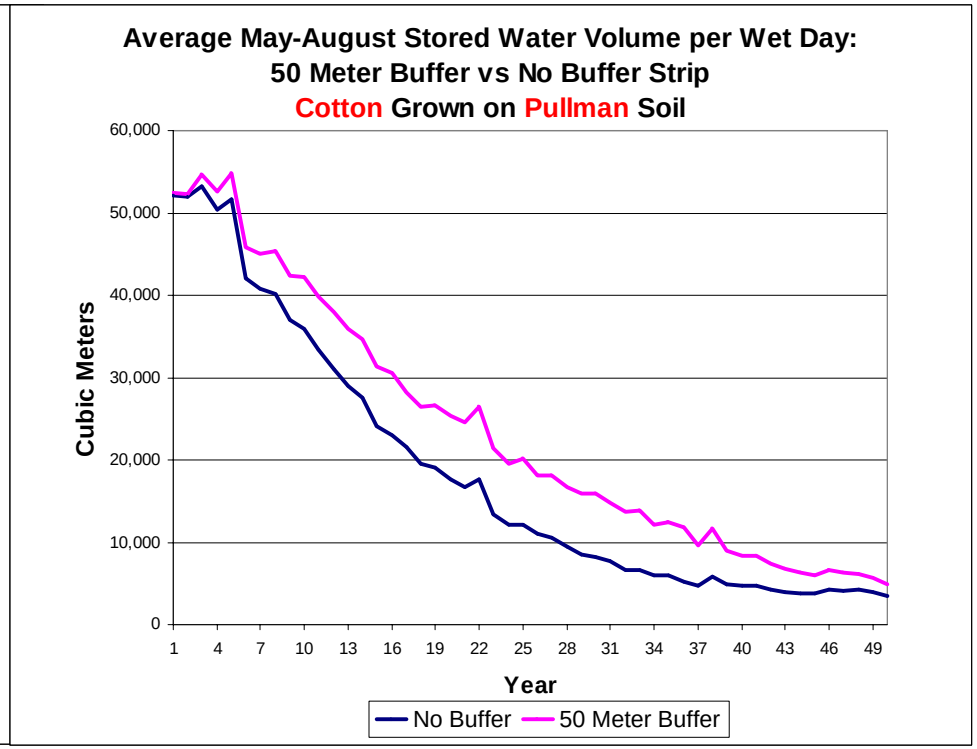


Controlling Agricultural Impacts

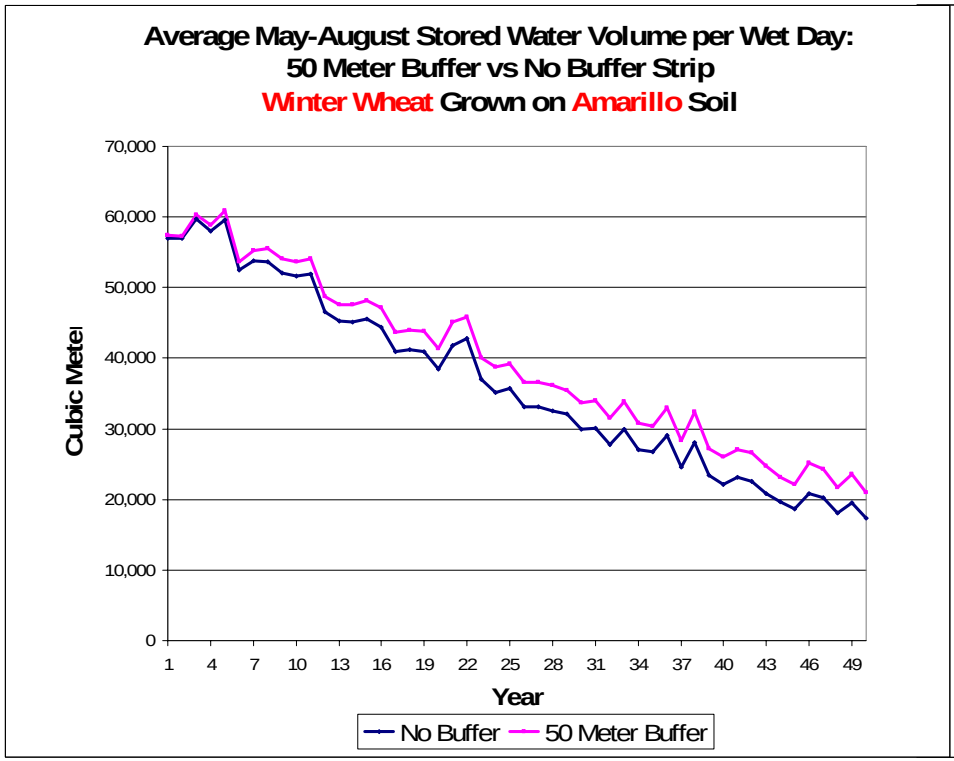
Effectiveness of Buffer Filter Strips in protecting Average Playa Stored Water Volume per Wet Day: May 1–August 31:

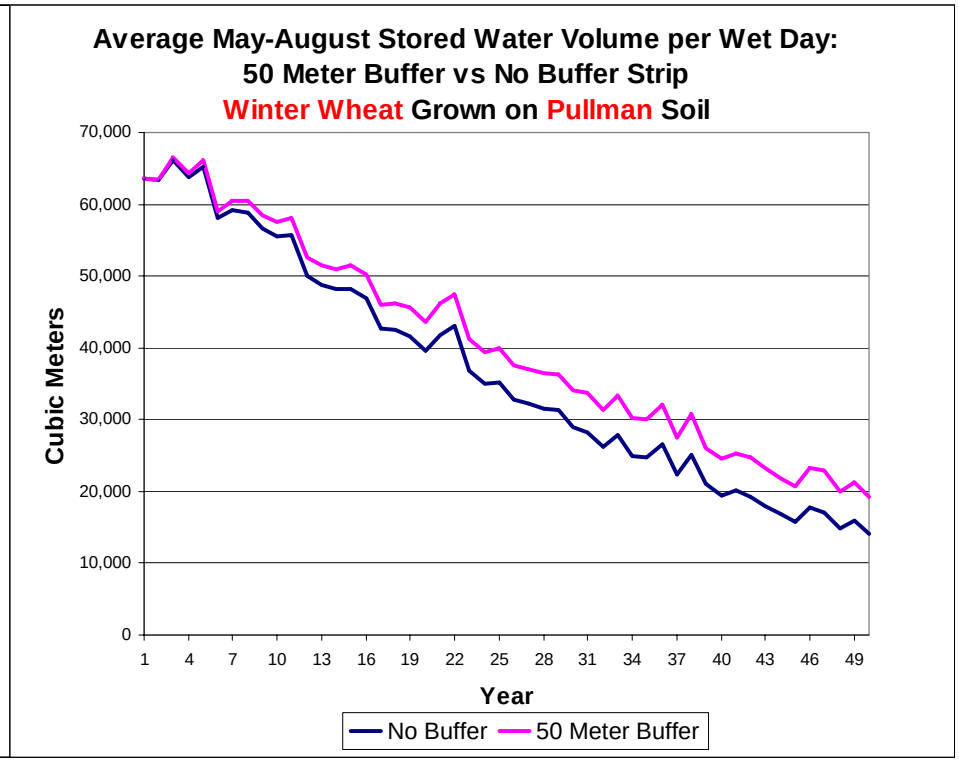
Buffer Filter Strip Effectiveness
Stored Water Volume/Wet Day: Cotton





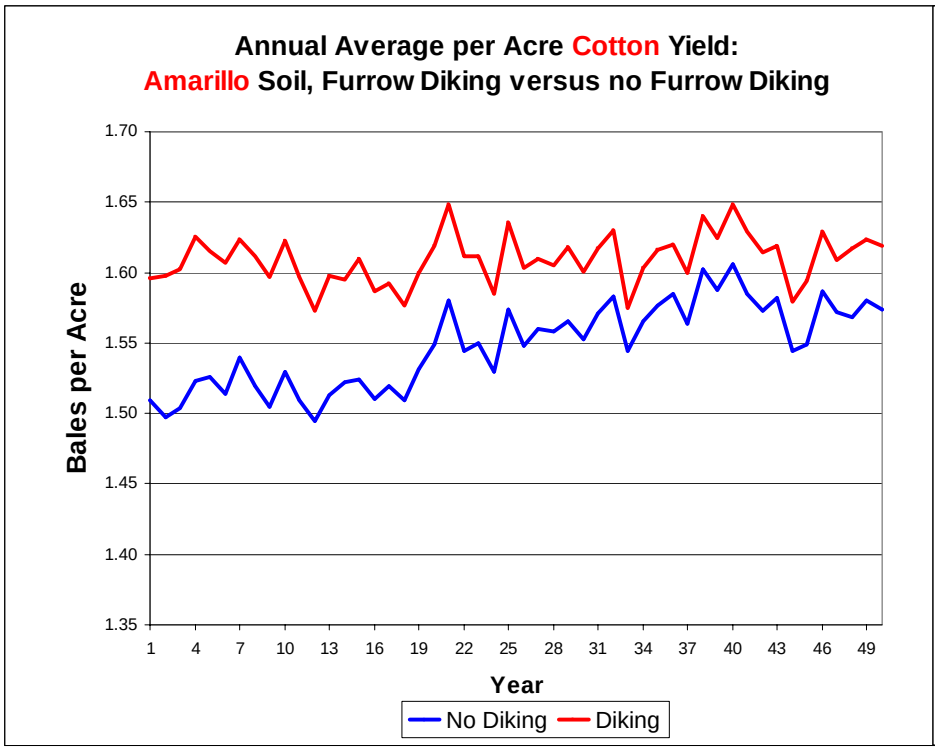
Buffer Filter Strip Effectiveness
Stored Water Volume/Wet Day: Wheat

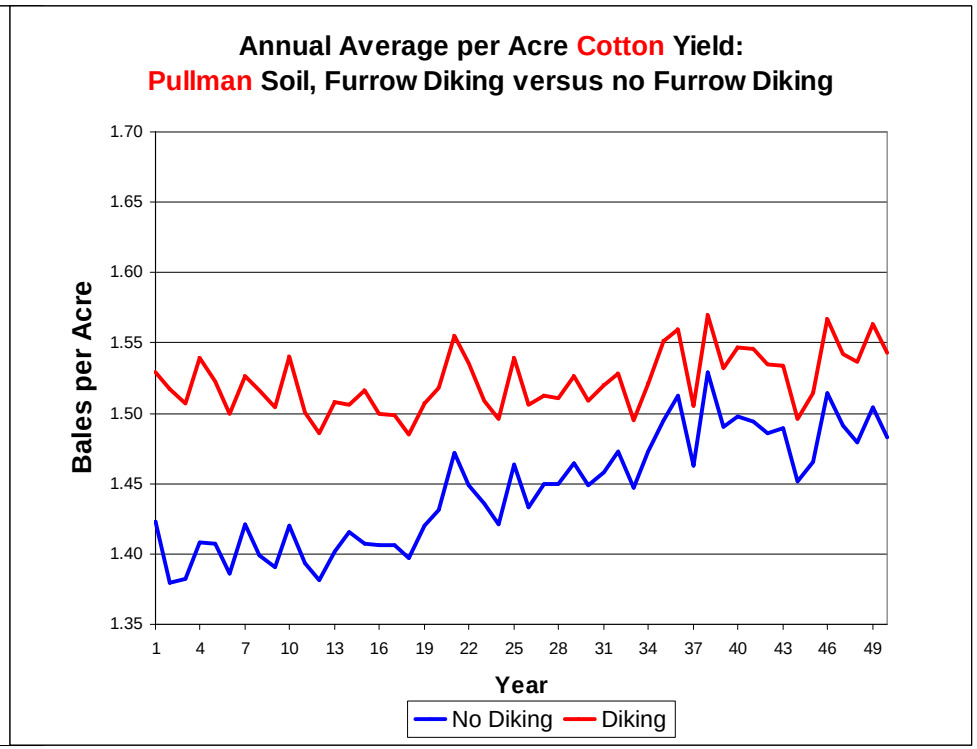




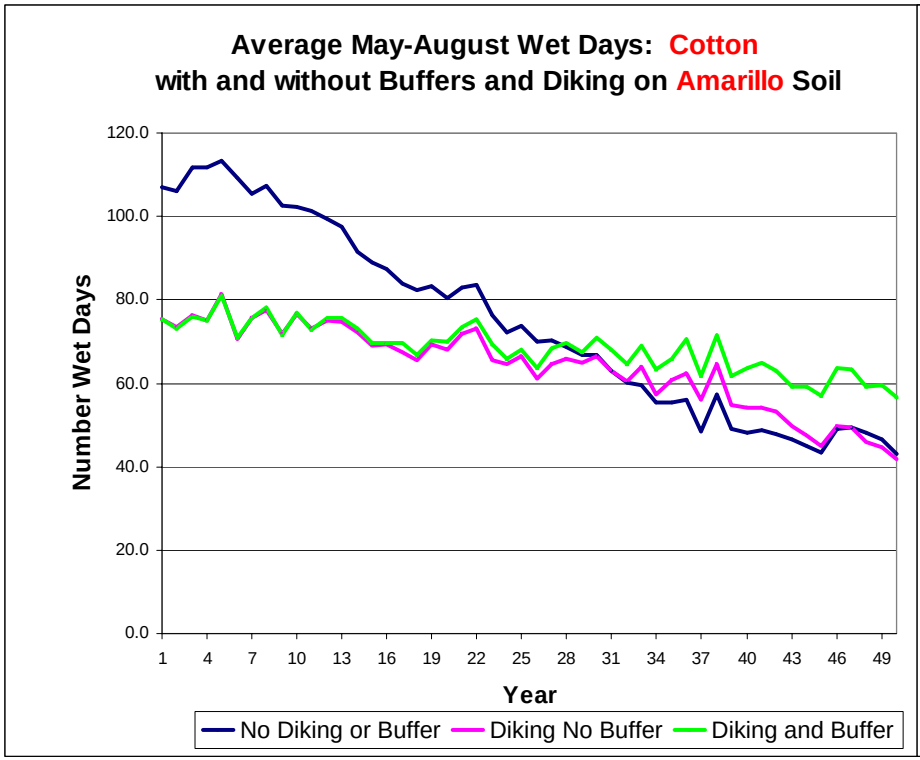
Impact of Furrow Dikes Yield and Erosion Impacts Cotton

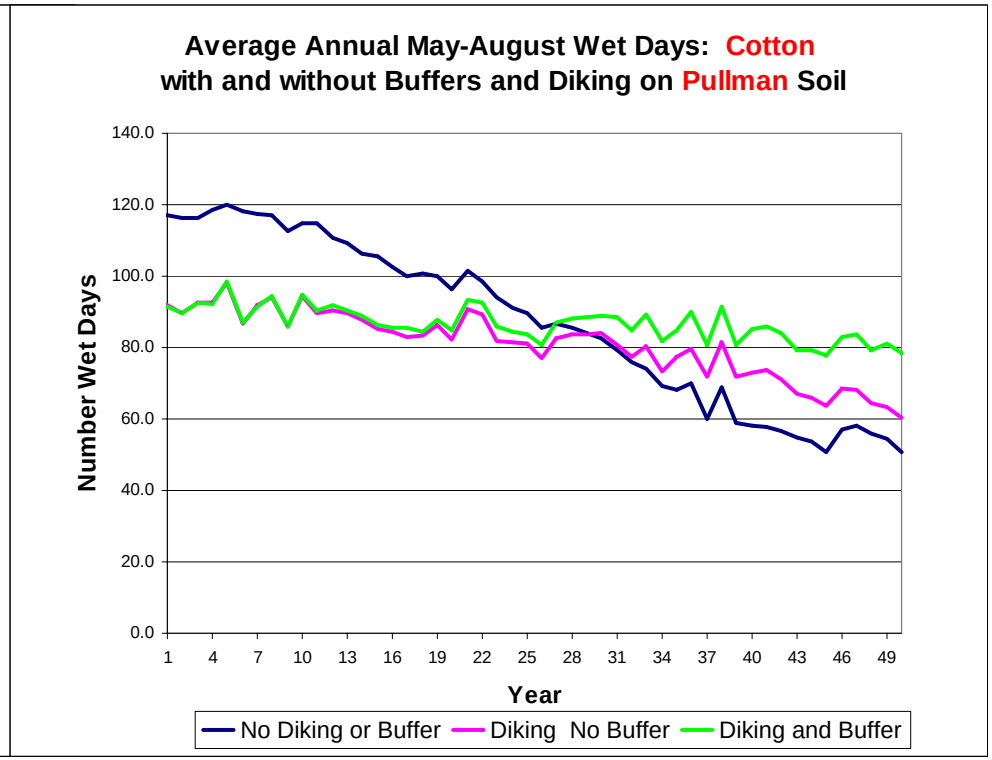
Furrow Dike Cotton Yield Impacts



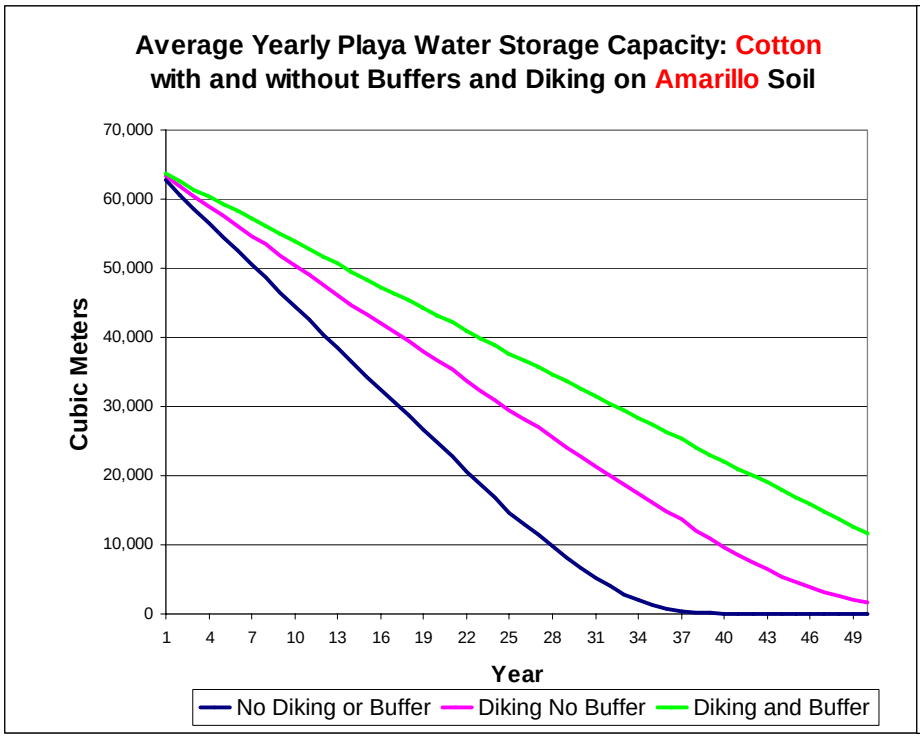


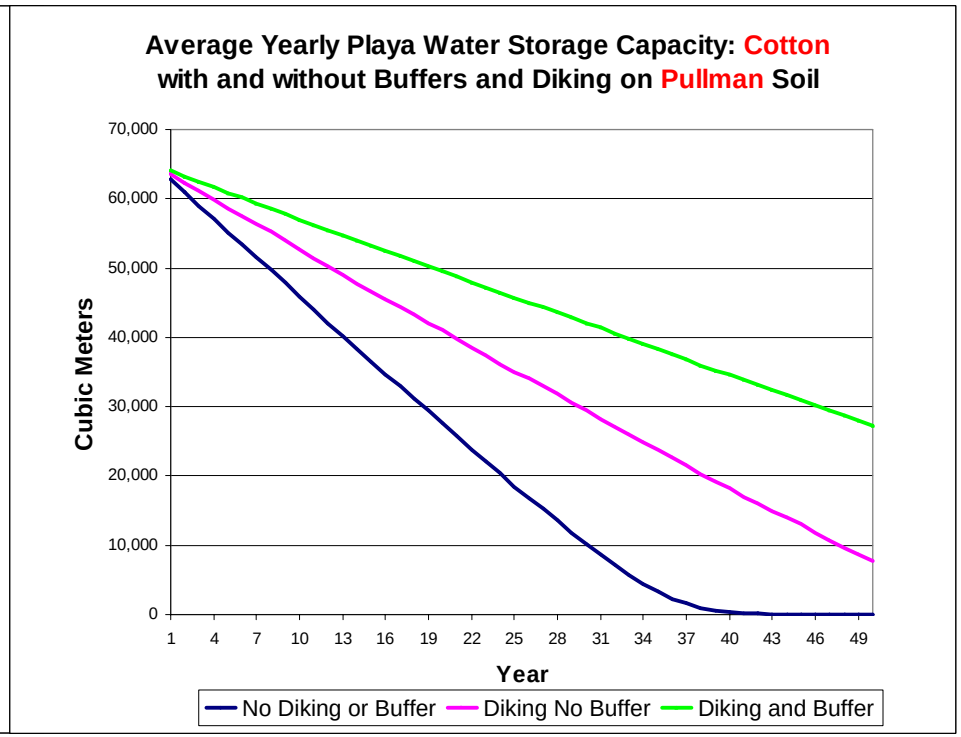
Control Practice Comparisons
Number of Playa Wet Days: Cotton



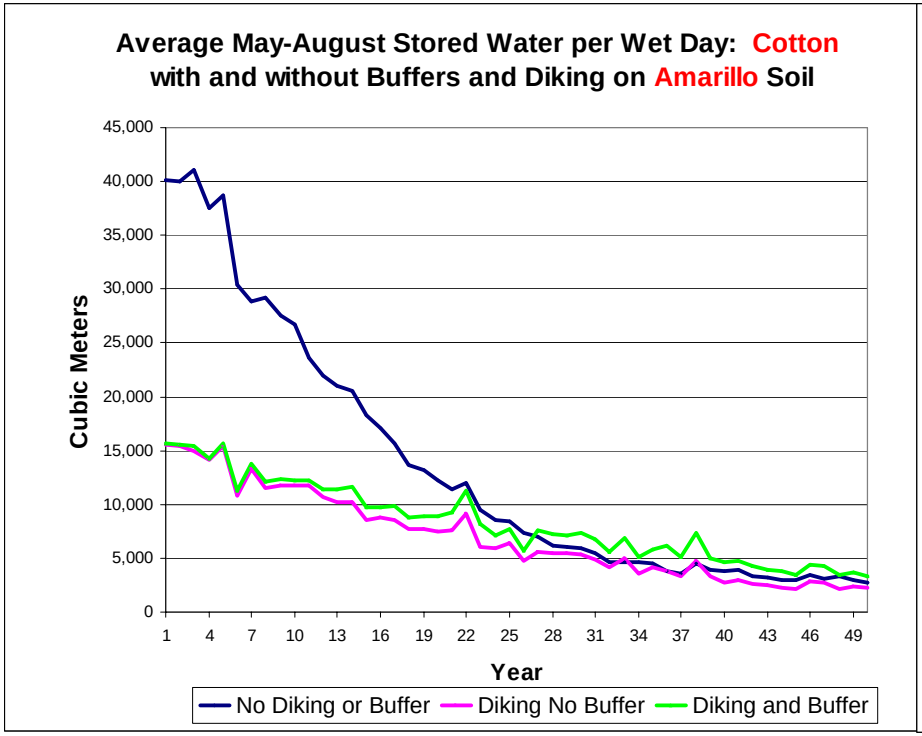


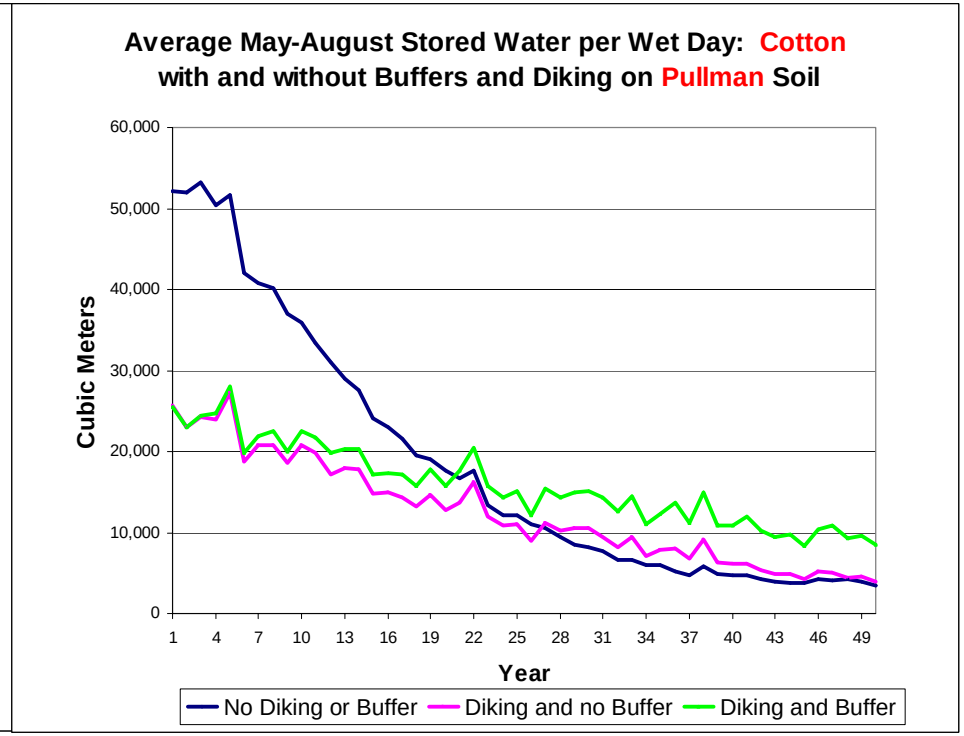
Control Practice Comparisons
Year-End Storage Capacity: Cotton



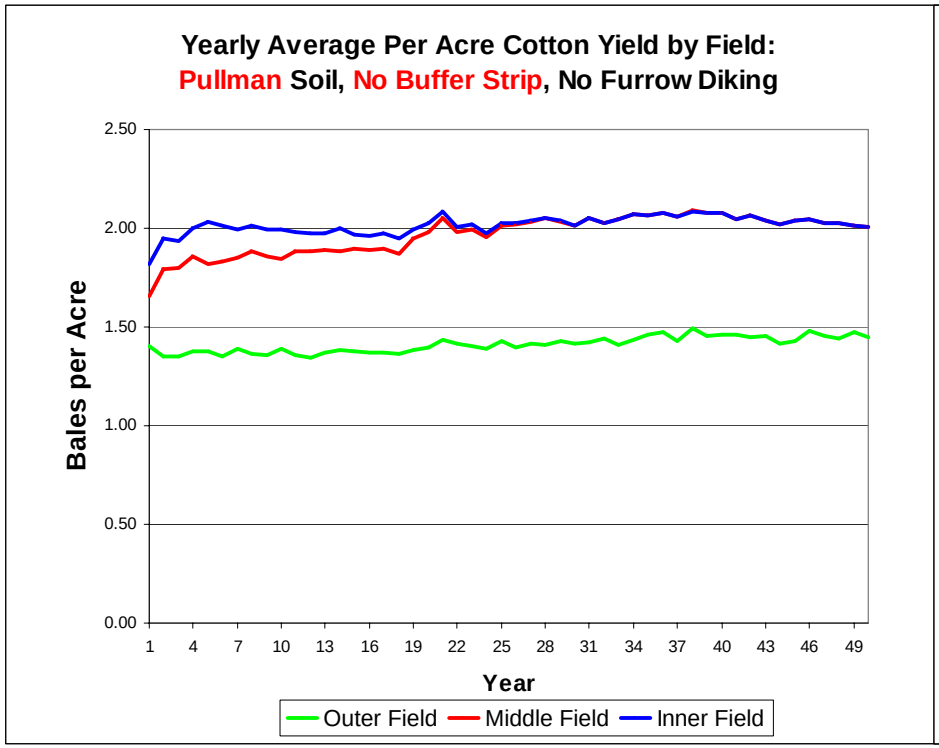


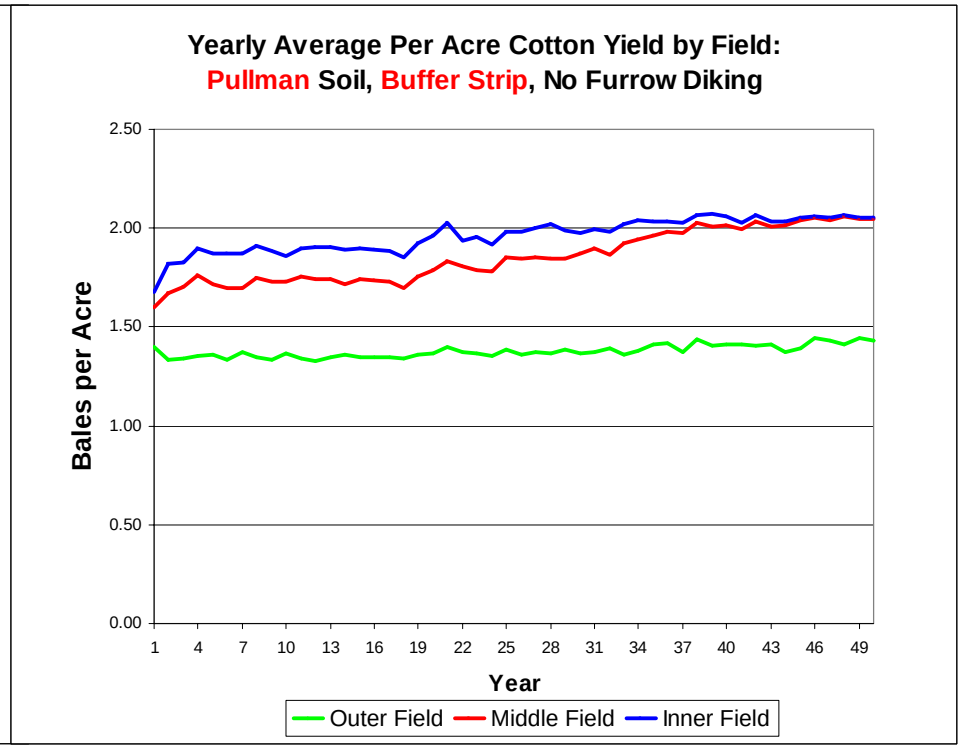
Control Practice Comparisons
Water Volume per Wet Day: Cotton





Average Simulated Yearly Cotton Yield Difference With Buffer Strip





Annual Producer Per Acre Cost of Buffer Strip By Crop, Price Scenario, and Soil Type Excluding Establishment Cost ($65.00)

		Amarillo Soil			Pullman Soil		
Price Scenario	Crop	Base to Buffer	Diking to Buffer (No Dike)	Diking to Buffer (w/Dike)	Base to Buffer	Diking to Buffer (No Dike)	Diking to Buffer (w/Dike)
Mkt Price + LDP	Cotton	-18.87	392.37	-6.24	29.09	609.16	101.15
Mkt Price + All GP's	Cotton	179.72	874.95	197.31	249.71	1187.20	352.62
Mkt Price + LDP	W Wheat	29.85			48.90		
Mkt Price + All GP's	W Wheat	130.83			159.39		

Annual Producer Per Acre Cost of Buffer Strip By Crop, Price Scenario, and Soil Type Excluding Establishment Cost ($65.00): No Buffer Yield Effect

		Amarillo Soil			Pullman Soil		
Price Scenario	Crop	Base to Buffer	Diking to Buffer (No Dike)	Diking to Buffer (w/Dike)	Base to Buffer	Diking to Buffer (No Dike)	Diking to Buffer (w/Dike)
Mkt Price + LDP	Cotton	-126.22	285.02	-111.24	-151.95	428.12	-133.10
Mkt Price + All GP's	Cotton	25.56	720.79	46.42	-10.26	927.24	15.99
Mkt Price + LDP	W Wheat	-75.59			-77.29		
Mkt Price + All GP's	W Wheat	-26.41			-28.80		

Summary and Conclusions

1. Agricultural land use practices reduce the (1) number of playa wet days, (2) volume of stored water per wet day, (3) and increase playa sedimentation rates relative to pristine range conditions
2. Buffer filter strips more effectively reduce sedimentation rates on silty-clay Pullman soil than sandy Amarillo Soil
3. Cotton production has a larger adverse affect on playas than wheat production
4. Furrow diking increases on-farm returns which increases producer opportunity cost of installing buffer strips
5. Government price support programs increase producer opportunity cost of installing buffer strips.

Summary and Conclusions

6. Additional work needs to be done to more fully calibrate APEX to Texas High Plains land use practices.
7. Need to correlate the number of wet days to an eco-system quality index
8. Identify critical environmental threshold levels
9. Establish minimum environmental safety standards
10. Account for stochastic weather in establishing minimum environmental safety standards.